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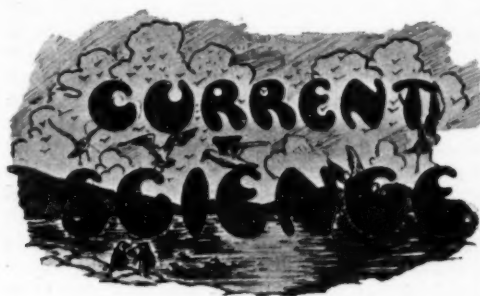
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## Lord Dawson's Bill.

THE debate on the motion of Lord Dawson for the second reading of the Bill, which he moved on the 13th February, to restrict the sale, display and advertisement of contraceptives, produced in the House of Lords quite a number of interesting speeches, which together with a critical examination of them by Dr. Marie Stopes, are published in the March number of *The Birth Control News*. The Bill passed the second reading by a large majority and was referred to a Committee of the Whole House.

It may be remembered that the law in relation to birth control varies widely in the Western countries. In Great Britain contraception is legalised, due probably to the realisation of the widespread practice of methods for spacing births or avoiding children and also to the recognition of the change in public opinion and withdrawal of opposition by the Church and the medical profession. In 1930 the Ministry of Health in its Memorandum 153 M. C. W. authorised local Public Health Authorities and private agencies to establish clinics for the dissemination of free Birth Control information to married women; in Russia and Mexico, the governments are actively interested in the propagation of contraceptive methods among all married people. Since 1920 France, alarmed at the shrinkage in her population, has set her face against birth control literature; Ireland and America have banned all practical information concerning contraception. Many of the smaller European states and also Australia and Canada prohibit the sale of contraceptive literature and apparatus; but in South Africa, Germany, India, China and Japan there are already birth control clinics and advisory centres.

In his otherwise lucid exposition of the doctrine of birth control, Lord Dawson of Penn has made some remarks which may be used against the very cause he so warmly espouses. The *ex cathedra* observation that "birth control is here to stay and is part and parcel of social fabric" is not likely to be accepted wholeheartedly by the Anglican Church in spite of the famous resolutions passed at the 1930 Lambeth Conference of Bishops, and is relentlessly opposed by the Roman Catholic Divines. It is true that every speaker in the House of Lords has testified to the fact that there is a rapid

spread of contraceptive practice in the country with its attendant evils; but all the same there must be a very large section of the community who still prefer to restrict the size of the family by exercising prudence and abstinence in conformity with the dictates of moral and religious conscience. If, however, present-day youth in the mass have decided on limitation of pregnancy and its determination by choice, we are disposed to think that their resolution cannot all be the outcome of the conviction that economic grounds and family reasons constitute the foundation of their families. On the other hand, the Lords Spiritual have depicted a dreadful picture of the abuses of contraceptives and the total effect of their speeches must be disquieting to all who have faith in the moral foundation of society and the authority of the Church. The object of the Bill is to protect and defend the young people from being prematurely introduced to contraceptive knowledge, for nothing can be more disturbing to the welfare of the society than sexual precocity in youth. If the blatant advertisement of birth control devices and the erection of automatic machines in the open thoroughfare could be prevented by legislature, the author of the Bill hopes that the innocence of youth will be sufficiently safeguarded. Any careful observer must have noticed that these are not the only baneful influences to which the young people are exposed, whose morals are often also corrupted by obtrusive advertisements of aphrodisiacs and abortifacients, unworthy films and sensational catch-penny novels. The Bill strives to remove only a couple of factors from an extensive environment whose influence in precociously exciting the morbid curiosity of children is as subtle as it is dangerous. The educational and domestic authority for fortifying the mind of youth in the principles of morality is frustrated by what youth sees and hears everywhere; and exposure of contraceptives to public gaze is not more damaging to the interests of public morality than are the other hostile influences.

If under the particular circumstances of this age, a married couple were by mutual consent to resort to birth control methods,—a course of action approved by Lord Dawson—it is maintained that the Church and society should not interfere with the personal predilections of people in a matter of such vital necessity for the health and happiness of the family and the improvement of children. There is hardly any happening even in the

best ordered homes of people, the knowledge of which can be kept sufficiently confidential for a long time and the greater the secrecy with which anything is guarded, the more irresistible is the curiosity of youth to explore, investigate and discover everything about the matter in its own time and in its own way. Once the knowledge of the existence of contraceptive goods is gained by children, they will most naturally proceed to try them: and all knowledge is communicable. The diffusion of such knowledge gained first hand in the very premises of their home must tend to destroy the innocence and value of childhood which the bill purports to protect. Moreover, as the Bishop of St. Albans has pointed out, if for economic and social reasons married people are to be permitted to impose limitation on the size of their family, there must be a still larger number of men and women who on economic grounds cannot at all marry. The problem of such people is at once delicate and difficult. Lord Dawson has given it as his solemn medical opinion,—though many will disagree,—that abstention is impossible and hurtful to health and that it must eventually lead to irregularities and perversions which may be criminal offences. If this is so the case of people who remain single after the marriageable age has been left behind, must constitute a serious problem fraught with sinister consequences to the welfare of the individuals concerned and the society to which they belong. If self-control, however valuable as a stabilizing element of human character, is deleterious to health, and the medical profession has provided the people with the means of avoiding responsibility for the biological consequences of their actions, unmarried people will have a strong incentive to resort to birth control methods. If the purpose of contraceptive philosophy is to exalt the gratification of the fundamental appetite on easy terms and without regard to the primary obligations with which Nature has invested it, will not marriage as a voluntary human institution for the propagation of the race tend gradually to become obsolete, with the possibility that the government may have to take it over as a branch of civil administration?

Almost all advocates of birth control start on the assumption that women have a natural aversion to child bearing, and even in cases where no pathological conditions are indicated, they point out that frequent pregnancy



must inevitably undermine the physical health and domestic happiness of the individual. Lord Dawson in describing the large families of the early forties of last century, such as the Gladstones and the Lyttletons, makes no reference to the injurious effects which a numerous family is reported to produce. It seems to us that if a mother suffers after moderate child bearing, ordinarily it must be due to want of sufficient food, clothing, accommodation and medical advice; and provided that all these things are procurable by every person in a requisite measure, so as to preserve his and her health on a reasonably high standard, can it be proved that moderate child bearing in such circumstances, produces the grave consequences which the birth control methods seek to prevent? According to Lord Ponsonby, what the majority of people require is suitable work, adequate wages, a cheap and sufficient supply of wholesome food and clothing, decent housing accommodation and free medical advice. It is one of the strange ironies of the present age that decent men and women are unable to obtain the reasonable comforts of life which their capacity to serve the body politic ought to procure. Lord Ponsonby further pointed out that when he was Under-Secretary at the Ministry of Transport, he was able to gather figures which showed that among the income-tax paying classes there was a greater increase in the purchase of cars than in the production of babies,—a fact which proves the growing tendency on the part of the professional classes and the rich to evade the responsibilities of tending and educating children and to spend all the available time and money in procuring personal enjoyments. It is doubtful whether birth control methods lend themselves to be used as correctives of the evils produced by a faulty social and economic system.

To our mind birth control methods only touch the fringe of the population problem, though their advocates claim that they produce happier homes, healthier motherhood and a better race of children endowed with a finer character. Lord Dawson has pointed out that this social ideal has permeated the skilled and semi-skilled working classes who have adopted the contraceptive practices so that a decline in the birth rate of 14.4 per cent. has occurred in Great Britain in the ten years between 1923 and 1933. The so-called "circumstances of the age" seem to be only synonymous with

unequal distribution of wealth, unemployment consequent on mass production and defective mechanism of marketing the produce and slums produced by factory labour. Are these disfigurements to be permitted to extinguish the nobler and heroic virtues which distinguished the older generation of men and women who, with fortitude, resource and self-sacrifice, reared a large number of children amid the picturesqueness of family love, loyalty, devotion and discipline? Perhaps a readjustment of the existing social system may secure for the people better homes, more money and greater means of enjoying the amenities of life than the practice of birth control methods can hope to place at their disposal. Is there not enough room in the British Empire for establishing and developing more colonies where the excess population can be properly placed to bring up their numerous children as self-respecting citizens without exposing them to the evils of the widespread use of contraceptives which is reported by the Lords Spiritual to be common among unmarried persons?

The prevalence of these evils is admitted by Lord Dawson and their increase is attributed to extravagant displays of contraceptives, the construction of automatic machines and shameful appeals to the young and old alike to purchase, and profit by, chemical preparations. The evils bitterly alluded to by the Lords Spiritual is traceable in no small measure to the attitude of the Church and society towards fallen women and their illegitimate offspring. To repress is to excite curiosity; to forbid is to stimulate action; this law of contraries is an essential ingredient of the human mind. Religion and society by steeping sex in shame ran it underground, and will both produce a constructive and feasible scheme for overcoming the biological consequences of fornication without absolute continence. Our attitude to the sex problem must change and the Church must develop a finer code of morality more practicable and convincing than the old one, which is no longer adequate and thus fails to check the evils of illicit intimacy. For the danger of these evils is intensified by the sophisticated food of civilised man, precociously stimulating the fundamental instincts, and by the fact that these instincts are fostered by the greater freedom of action now enjoyed by the members of both sexes and by the deeper and subtler influences of environment.

A more significant population problem than the quantity of mankind, is the quality of individual members. In order that a nation may become prosperous, happy, efficient and peace-loving, a sound contribution to general intelligence and moral stability has to be made by all the grades and classes of society. The mere limitation of the family which may perhaps secure for the children a better average of education and a more decent start in life, does not ensure that all the children born under the contraceptive auspices will possess the best qualities. It is doubtful whether even the creation of a Ministry of Marriages, such as Charles Whibley cynically suggests, assisted by a Secretariat of bright-eyed young Mendelians, could, by selective breeding, produce and fix the desirable type of individuals, for "men and women are not peas" and they must have their own personal inclinations which are beyond the range of experimental marriages. Heredity is a supremely fruitful field but its mechanism still baffles human ingenuity. The very essence of strength and beauty of humankind is individuality, which is divergence and the ambition to fix the type, even were it possible, must be undesirable. Neither birth control methods nor all the tender faith in the efficacy of legislature will suffice to improve mankind; we shall have to rely on education, public opinion and the precepts of religion for its betterment, however true it may be, that the son profits little by the intellectual and moral acquisitions of the father and has to begin it all over again from the very commencement.

If we really want our people to flourish then we should give every one an equal chance to succeed in life: and, knowing that the people who, possessing the highest inborn intelligence and moral energy, are the ones who are actually contributing most to the welfare of the community, we have to encourage them to have as many children as

they healthily can in the hope that being born of a good stock in a good environment, they may repeat or improve on the worthiness of their parents. It may perhaps be necessary to discourage the people who are decidedly inferior to have numerous children. The indiscriminate and extensive employment of contraceptive technique by the professional and richer classes alone and the inability of the less favoured community to procure birth control advice and appliances must produce results whose consequences to the nation will be obviously unsatisfactory. If any bill on the subject of birth control is needed, legislative sanction should be obtained to prohibit the sale of contraceptives to the well-to-do classes and to place the appliances within the easy reach of others whose contributions to the prosperity of the people must in the nature of things be somewhat lower. Many of the social abuses now attending the propaganda of birth control knowledge and free sale of contraceptives, which the Lords Spirituals have painted in lurid colours, may be removed by restricting their purchase at specified hours during day time in a few licensed shops and on the production of a certificate from a competent medical authority that the purchaser is married and that the goods are intended exclusively for his personal use. The birth control movement is in the nature of a physiological and psychological experiment, regarding the results of which there is not a unanimous and authoritative body of opinion; and it is neither safe nor wise to permit it to gamble with life without sufficient safeguards. Nevertheless the question of birth control and the law of abortion must, as pointed out by Justice McCardie, be investigated free from prejudice whether theological or otherwise; and if the problems were to be treated like other scientific problems, perhaps their implications might lose many of their horrors.

## The "Direct Control" Autogiro.

By Colonel John Josselyn, C.M.G., D.S.O., O.B.E., T.D.

IT is safe to assume that most people nowadays are familiar with the Autogiro either from actually having seen one on the ground or in flight or from pictures, literature, or hearsay. It will therefore be enough to say that the Autogiro is an aircraft which obtains its lift entirely from a system of rotating blades, called the rotor blades, mounted on a pylon structure attached to the fuselage in place of the usual centre section of the ordinary fixed wing aeroplane. These blades are hinged at the root allowing freedom of movement up and down as the rotor revolves. Once in the air no engine power of any kind is required

aircraft. If the blade were not hinged then the lift on the advancing blade would be considerably greater than that on the retreating blade, but the hinge allows the blade to rise, decreasing its incidence and thereby its lift. On the other hand, the fall of the retreating blade increases its lift with the result that the lift on the blades is equalised and the resultant lift of the whole rotor is fixed at or very close to the centre of rotation of the blades.

Considering then the action of the disc formed by the revolving rotor blades, we find that, again owing to the forward speed, the tip of the blade at the front of the



to keep the rotor system revolving, its rotation being entirely due to aerodynamical action.

If one considers the action of the blades in flight, it is found that, due to the centrifugal force and the lift acting simultaneously, the blade will assume an angle to the normal. Now if the path of the tip of the blade is traced it will be seen to rise and fall, the rise taking place during the period in which the blade is advancing, and the fall during the period of retreating. When the blade is advancing the speed with which it travels with respect to the opposing wind is increased by the forward speed of the

machine is higher than that of the rear blade, so that the plane of the disc is inclined backwards and slightly down on the side of the advancing blade. The direction of the lift force will be normal to this plane. Lateral and directional stability is maintained by small fixed horizontal oblique and vertical fin surfaces at the tail of the fuselage.

One of the difficulties under which the Autogiro has to some extent suffered during the years of experiment in perfecting the rotor system has been the question of the degree of control at the slow speeds at which the machine is capable of being flown

with perfect safety and freedom from any possibility of stalling, and in vertical descent when there is no forward speed at all.

The basic problems of flight are three: Lift, Stability and Control. The Lift of an Autogiro and its safety and stability are fundamentally independent of its horizontal speed through the air, unlike the ordinary fixed wing aeroplane which is entirely dependent for its lift and stability and consequent safety on the maintenance of a high forward speed through the air. On the other hand, the degree of control obtained by means of ailerons, elevators and rudder as in the fixed wing aeroplane is dependent on the speed at which these control surfaces are forced through the air. Consequently in the lowest forward speeds, or in vertical descent, such as are possible with the Autogiro from the point of view of lift and stability the ordinary fixed wing aeroplane controls were sluggish and almost ineffective. In order to overcome this difficulty Mr. de la Cierva, the inventor of the Autogiro, and the person who has been responsible for its development throughout, contrived what is called the "direct control" arrangement, whereby control is no longer dependent on small moving surfaces attached to fixed planes but is transferred to the rotating disc which is the whole supporting surface of the machine.

This type has therefore no fixed wings or control surfaces such as ailerons, elevators or rudder, the only fixed surfaces being fixed horizontal, vertical and oblique fins at the tail of the fuselage to give the machine directional and lateral stability and to counteract the effect of propeller torque.

In considering the action of the rotor blades in flight we have found as follows:—

1. That the lift force is roughly constant for a given attitude of machine.
2. That it acts at the centre of rotation of the blades.
3. That its direction is normal to the plane of the rotor disc.

As has been indicated above, the control of ordinary aircraft is achieved by altering the load on any of its control surfaces by changing the attitude of the surface with respect to the wind. In the new type of Autogiro the alternative of changing the direction of a force is employed. As the lift force acts normally to the plane of the disc of the rotor, if the attitude of this disc is changed by tilting the rotor then the direction of the lift force will be changed also.

To show how this works on a machine in flight see Fig. 1.

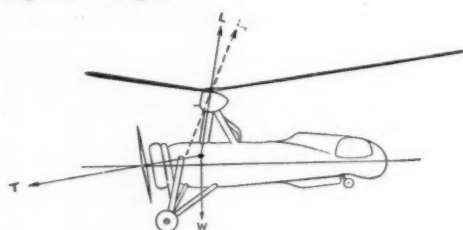


Fig. 1.

The thrust (T), weight (W), and lift (L), are shown acting at the C. G. of the machine and in equilibrium, for simplicity the tail load is neglected. This condition would give no tail load.

It will be clearly seen that if the direction of the lift force (L) is changed to that shown by the dotted line, this force will have a moment tending to raise the nose of the machine. In the same way if the rotor is tilted forwards in the opposite direction to that shown by the dotted line, it will raise the tail of the machine. Exactly the same results are obtained laterally if the rotor is tilted sideways and any combination of these fore and aft and lateral movements will produce corresponding movements in the machine.

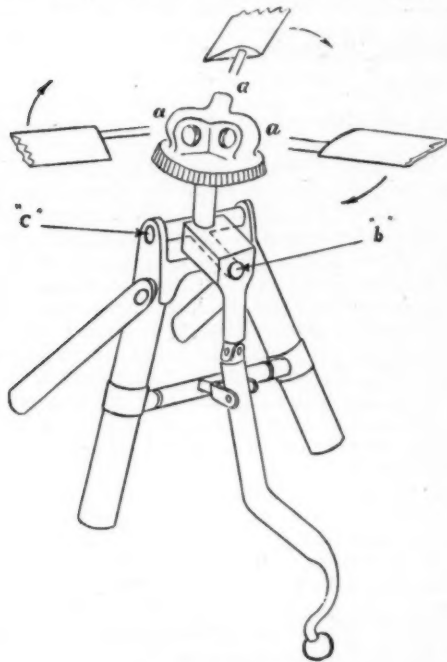
So much for the fore and aft and lateral controls, but this "direct control" machine dispenses also with a rudder and some explanation of how it is turned without a rudder is necessary for a complete understanding of this novel aircraft. It is a well-known fact that a machine put into a bank without rudder will side-slip. Immediately this side-slipping commences it is equivalent to a change of direction of wind which will now press against the side towards which the machine is slipping, with the result that, exactly as a weathercock changes direction with a side wind, so an Autogiro with its large tail surfaces will change direction also. It will be seen then that to bank is automatically to turn. The lateral control on this type of machine might be referred to as the turning control.

Before going on to a description of the machine itself, it may be as well to explain how the propeller torque is counteracted in a machine of this type. In ordinary aircraft it is usual to counteract propeller torque by a differential setting of the ailerons. As there are no ailerons on the



“direct control” Autogiro, it is necessary to have this change of setting incorporated in the horizontal fin. A number of experiments were carried out to determine exactly what this setting should be, and it was found that if a certain aerofoil was given to the horizontal fin and reversed on one side, the propeller torque would be corrected.

Fig. 2 is a diagrammatic sketch of the hub and controls. It should be explained



**Fig. 2.**

that actually the axle is not connected to the lateral hinge housing directly as shown in the sketch, but is mounted in ball bearings in the hub, the bottom cover of which forms the hinge housing.

It is essential in a control of this type that friction should be eliminated as far as possible, and with this end in view, needle roller bearings are used at all hinge points.

The three blades are attached at the hinges marked "a" and the whole of the rotor system is free to turn about the hinges "b" and "c". These hinges are offset from the centre of rotation and the reason for such offset lies in the inclination of the lift force which has been explained above. The offset is such that the line of lift never passes

through the hinges but slightly behind the longitudinal hinge and to starboard of the lateral hinge. When it is explained that for full control of the machine no more than 4° or 5° longitudinal tilt and 2° lateral tilt is required, it will be appreciated that the load on the hand necessary to control the machine must be small and the control very sensitive.

As a matter of fact, the control was found to be so light and so sensitive that during test flights it was found necessary to introduce flexibility into the system to diminish the sensitivity and to give the control a bias in order that the pilot may have a "feel" to the control. This bias, which is given both laterally and in the direction of tilting the rotor backwards, is merely an extra load supplied by springs, the strength of which was found by experiment.

From the sketch it will be simple to follow the control and it will be seen that, though with a hanging stick instead of one with controls attached at the floor of the fuselage, the control movements are exactly similar to those of orthodox craft, that is stick back to climb and forward to dive. In addition, as previously explained, the left or right stick movement will give a left or right bank and turn of the machine.

A brief description of the machine C. 30 P. (as illustrated) is as follows:—

**Engine.**—Armstrong Siddeley "Genet Major"  
7-cylinder, approximately 140 h.p.

**Propeller.**—Fairey Reed metal propeller.

**Fuselage.**—Steel type welded construction seating capacity for pilot and passenger in open cockpits.

**Undercarriage.**—Split axle type—axle oleo leg and radius rod attached to fuselage—travel of oleo leg about 8". Dunlop intermediate pressure wheels fitted with Bendix brakes. The undercarriage is fitted well forward on the fuselage—more so than is customary, to enable the engine to be run up on the ground without the tail rising. It must be remembered that there are no elevators to use during this operation.

**Vertical Fin.**—Steel tube welded construction, disposed equally about the centre line of the fuselage.

*Horizontal Fin.*—Wooden construction. The horizontal fin is provided with oblique fins which give added stability in all directions, lateral, longitudinal and directional.

**Petrol System.**—Gravity tank of 25 gallons capacity being sufficient for 3½ hours' flight.

**Oil System.**—An oil tank is fitted containing about 34 gallons of oil.

**Rotor Blades.**—Steel tubular spar internally tapered, with ribs for shaping a ply covering.

**Rotor Starting.**—The starting of the rotors is accomplished by engaging a clutch, the driving side of which is driven by the engine. A lever in the pilot's cockpit operates the driven side. The drive is through bevel gears and a dog clutch

which is provided to ensure that the rotors could never over-run the engine. If this ever happened the two halves of the dog clutch would ride over each other. When the requisite number of revolutions of the rotor are obtained the clutch is disengaged by a quick release, situated on the pilot's dashboard.

**Ground Steering.**—The tail wheel of the C. 30 is steerable and is operated by a foot steering bar in the cockpit.

**Performance.**—No actual performance figures are available at the present time but, based on

experience of former Autogiros, the following performance should be obtained :—

Top Speed	.. 120 m.p.h.
Minimum Flying Speed	.. 15 m.p.h.
Cruising Speed	.. 95 m.p.h.
Landing Speed	.. Nil.
Take off run	.. 12 yds. in still air.
Landing run	.. Nil.
Range	.. 3½ hours, approx. 350 miles.
Ceiling	.. 17,000 feet.
Climb	.. 900 ft. per min.

## On the Mechanism of Indian Tornadoes.

By Dr. A. K. Das, D.Sc.,  
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IN an article which appeared in the *Current Science* of June, 1933, I made the suggestion that tornadoes with the characteristic cloud funnel which occasionally occur in Bengal during the nor'wester season might be due to the downward bending of one end of the cylindrical whirl with a horizontal axis which should sometimes come into existence as a result of the mechanism of nor'westers which I put forward in a fairly detailed investigation<sup>1</sup> published in the *Gerl. Beitr. z. Geophysik*. The mechanism suggested for Bengal tornadoes could not at that time be supported by definite observational data of any actual tornado because such data were not available for any tornado of Bengal or of any other part of India; but the mechanism was perfectly in line with A. Wegener's theory of European tornadoes and appeared to me to be a necessary extension of the mechanism of nor'westers that would explain more satisfactorily the close relationship between the nor'westers and the tornadoes than other suggestions which postulate the pre-existence of local upward convections due to the overheating of the ground and consequently of the air in contact with it. There is ample evidence in meteorological literature to shew that the true upward movement of air through the tornado funnel is to be regarded as a subsidiary phenomenon and in fact, in some tornadoes its very existence is doubtful. It is to be remarked that the fact that objects are lifted up from the ground by tornadoes does not necessarily prove the existence of vertical convections of air in the tornado funnel.

In a paper<sup>2</sup> which has just appeared in the *Scientific Notes of the India Meteorological Department*, Flt. Lieut. R. G. Veryard has studied a tornado which occurred at Peshawar on the 5th April, 1933. This investigation is of great interest from the standpoint of Indian meteorology because it is the first paper which gives concrete scientific observations on the subject of tornadoes in India. Since Mr. Veryard intends to make in future a fuller study of this tornado I do not wish to utilise the data published by him in any other way than to indicate some of the features which appear to me to support the hypothesis put forward in my article in *Current Science* referred to above. The seven remarkably good photographs (showing the different stages of development of the tornado) which accompany Mr. Veryard's paper are extremely instructive from the point of view of the above hypothesis. On the first three photographs which represent the growth of the tornado the axis of the cloud funnel shows a gradual tendency to become vertical till on the fourth photograph which shows the fully developed stage the lower end of the funnel is almost vertical. On the three photographs showing the later stages one can see that the tornado is weakening and the axis of the funnel is steadily tending to become horizontal. Furthermore all the photographs show that at every stage the top of the funnel is sharply bent towards the cumulo-nimbus cloud and is joined up with it. It would, therefore, be natural to conclude that the original "mother whirl" with horizontal axis was inside the mass of cumulo-nimbus cloud and

<sup>1</sup> A. K. Das, "On the Mechanism of Thunder-squalls in Bengal,"—*Gerl. Beitr. z. Geoph.*, Bd. 39, 1933, pp. 144-160.

<sup>2</sup> R. G. Veryard, "A Preliminary Study of a Tornado at Peshawar,"—*Sc. Notes Ind. Met. Dept.*, 5, 56.

that in the initial stages one of its ends became elongated and gradually tended to be vertical (growth of the tornado) and later it gradually bent back to horizontal and shortened (decay of the tornado) until it disappeared finally inside the cloud.

The tornado moved approximately from S.W. to N.E. and Mr. Veryard says in his paper, as he also informed me on my enquiring about it before his paper was published, that looking from south-west to north-east the tornado funnel which had an anticlockwise rotation was situated on the right-hand side of the main cumulo-nimbus tower and the rain and hail fell mostly on the left-hand side of the track. This is a very interesting and important observation from the point of view of the hypothesis of the whirl with horizontal axis. That the tornado funnel was situated on the right of the main cumulo-nimbus cloud looking in the direction of translation of the tornado is quite evident from the photographs if we take account of the fact that they were taken while the tornado was approaching the camera. On all the seven photographs the top of the funnel is bent towards the cumulo-nimbus cloud, i.e., towards the right (as seen on the photographs) and it is on this side that there are indications though faint, of falling rain on some of the photographs. All these observations are strongly in favour of the hypothesis of the whirl with horizontal axis, and although from the

study of only one case it is not justified to conclude with certainty about the correctness of the hypothesis in the case of Indian tornadoes in general, there is good reason to believe that the hypothesis is a very probable one; it would, of course, be necessary to have more detailed observations in order to subject it to a strict test.

Another very interesting point in Mr. Veryard's paper is the observation that the tornado funnel in question had two parts: an inner core and an outer mantle. It may be remarked that similar observations have also been made in European tornadoes particularly by Wegener and Letzmann, so that the similarity of the Peshawar tornado with those of Europe would appear to be very close indeed. It also appears to me that on the photograph showing the tornado at the fully developed stage one can even recognise three distinct zones; this would probably suggest the presence of a central core, an outer mantle and an intermediate zone as proposed by Letzmann<sup>2</sup> from theoretical considerations. If the velocity of the wind and the lowering of pressure in the tornado were available one might subject this tornado to a quantitative test to some extent.

<sup>2</sup> J. Letzmann, "Über die Einflüsse positiver und negativer Beschleunigung auf ortsfest rotierende Flüssigkeitssäulen,"—*Gerl. Beitr. z. Geoph.*, 1930.

### Focal Region of the North Bihar Earthquake of January 15, 1934.

By Dr. S. C. Roy, M.Sc. (Cal.), D.Sc. (Lond.).

IN his note\* on the North Bihar Earthquake of January 15, 1934, Dr. S. K. Banerji has quoted the following epicentral distances of the earthquake estimated from seismic records:—Bombay 950 miles, Kodalkanal 1,400 miles, Agra 450 miles, Dehra Dun 100 miles, Mangalore 1,250 miles and Kew 4,600 miles. In addition to the foregoing distances one should also take into account the epicentral distance of 70 miles estimated by Calcutta. As pointed out by Dr. Banerji, these distances do not fix up any definite epicentre, but it would be premature to express an opinion regarding the extent of the focal region without a thorough scrutiny of the seismograms of all Indian Stations.

\* *Curr. Sci.*, 2, 326, 1934.

It is undoubtedly true that the origin of an earthquake cannot be traced to a point-source but it is probably equally certain that the focal region from which the seismic waves of the principal shock of January 15 originated could not have been as wide as is suggested by the epicentral distances originally reported by the Indian seismic stations. Discarding the incredibly low values of 100 and 70 miles reported by Dehra Dun and Calcutta respectively, the original estimates of the epicentral distances made by other Indian stations are, however, reconcilable to a focal region of reasonable extent when it is remembered that the seismic tables used for the estimation of the epicentral distances are different at different stations. The Dehra Dun seismograms are not available for

scrutiny but a preliminary examination of the Calcutta seismogram (Fig. 1) along with the seismograms of Agra (Fig. 2), Bombay (Figs. 3 and 4) and Kodaikanal (Fig. 5) suggests that the original estimates by Calcutta



Fig. 1.

and Dehra Dun were based on some wrong identification of phases on their seismograms. In the absence of the Dehra Dun seismograms it is difficult to imagine the exact nature of identification of phases which led to the low value of epicentral distance reported by that station but the following suggestion may provide a possible reconciliation of the original estimates of Calcutta and Dehra Dun.

The nature of incidence of the first preliminary waves  $P_m$  on the Agra, Colaba and Kodaikanal seismograms (Figs. 2, 3, 4 and 5) is similar and appears to correspond to the point  $P_m$  marked on the Calcutta seismogram (Fig. 1). The very feeble movements which commenced at  $P_m$  on the Calcutta seismogram prior to the incidence of  $P_m$  and lasted for about 11 seconds, are doubtful on the Agra seismogram (Fig. 2) and are not at all traceable on the Bombay and Kodaikanal seismograms (Figs. 3, 4 and 5). An explanation that suggests itself is that the major failure which led to the principal shock was preceded by a minor failure by about 11 seconds and that Calcutta's original estimate of the epicentral distance was based on the supposition that the interval ( $P_m - P_m$ ) represented the total duration of the preliminary and secondary waves of the principal shock. It is also not improbable that Dehra Dun adopted the same interval ( $P_m - P_m$ )

as representative of the duration of the preliminary waves. In this connection it may be of interest to mention certain seismic phases characteristic of near earthquakes of shallow focal origin. A glance at the seismic data published annually by the Indian stations seems to show that the Indian seismology has not in the past recognised fully phases of the preliminary and the secondary waves other than the normal P and S. It is, however, well known that the preliminary and the secondary waves of shocks originating in the upper layer or crust of the earth can travel to a near station along three distinct paths. The normal primary waves P and the secondary waves S are refracted down into the ultra-basic layer where they travel with comparatively high velocities and are refracted up again to the observing stations. The longitudinal and the transverse waves can also travel directly from the focus to the observing station through the granitic layer (about 10 Km. thick) where they have comparatively low velocities. These direct waves are recognised internationally by the

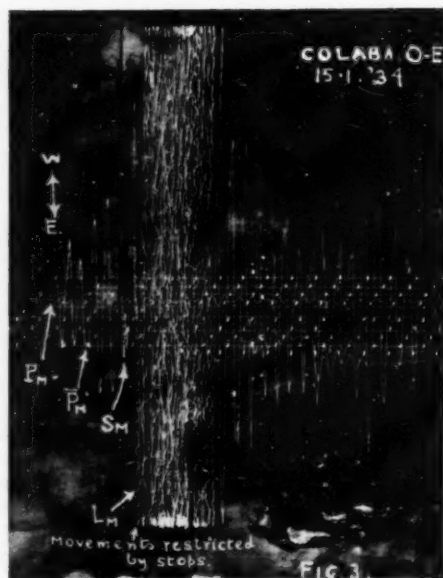


Fig. 3.

symbols  $\bar{P}$  and  $\bar{S}$ . In addition to the two pairs of preliminary and secondary waves mentioned above there is a third pair  $P^*$  and  $S^*$  which travel from the focus to the



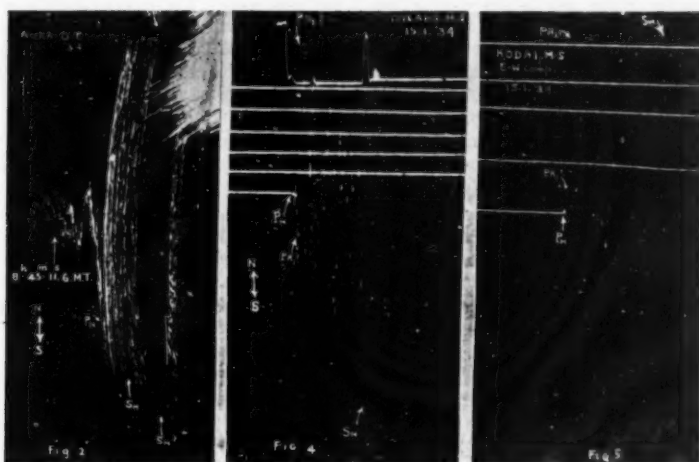


Fig. 2.

Fig. 4.

Fig. 5.

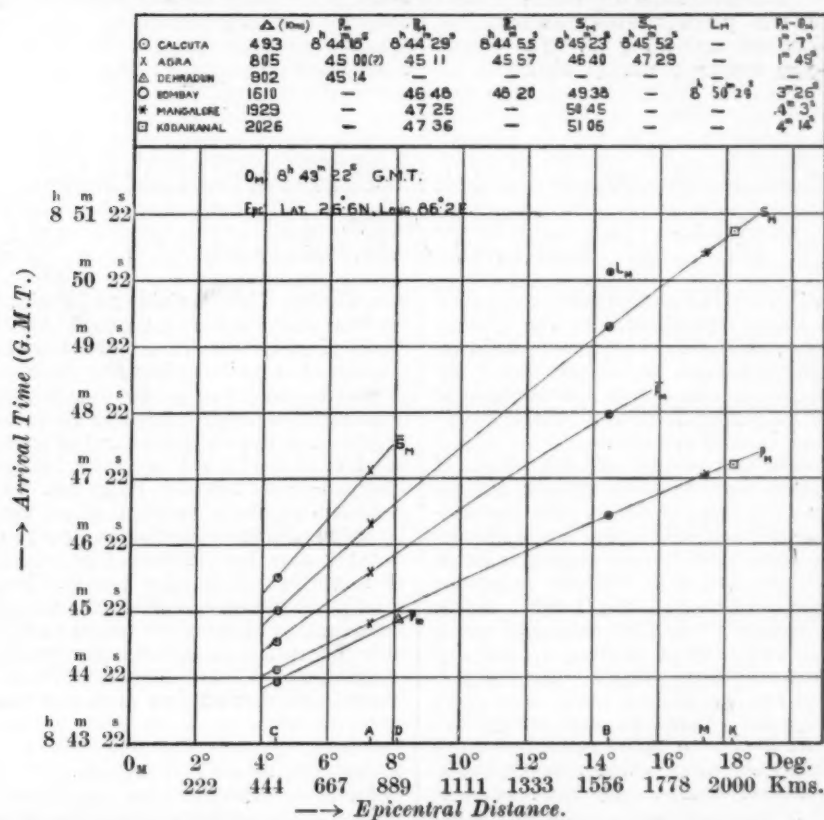


Fig. 6. Time-Distance Curves of North Bihar Earthquake of January 15, 1934.

observing station with intermediate velocities through the basaltic layer (about 20 Km. thick). The importance of the recognition of these six phases and also of the reflected primary and the secondary waves for a correct diagnosis of seismograms of near earthquakes cannot be over-emphasised. The phases  $P_m$ ,  $\bar{P}_m$ ,  $S_m$  and  $\bar{S}_m$  appear to be identifiable on the seismograms of Calcutta and Agra (Figs. 1 and 2). The reflected waves are also traceable on some of the Indian seismograms (Figs. 2, 4 and 5) but the phases  $P_m^*$  and  $S_m^*$  are either absent or difficult to trace. One is naturally tempted to suggest that the phase  $P_m$  marked on the Calcutta seismogram may be taken as  $P_m$  and the phase marked  $P_m$  identified as  $P_m^*$  but the feeble nature of the movements of  $P_m$  and other characteristics of the Calcutta seismogram do not appear to support such an explanation.

The arrival-times of the important phases based on the present identification are tabulated at the top of Fig. 6. The origin time of the major shock was obtained by plotting  $(S_m - P_m)$  interval against the

arrival time  $P_m$  is 8 h. 43 m. 22 s. G.M.T. The epicentre is located near Lat.  $26.6^\circ$  N., Long.  $86.2^\circ$  E. in agreement with the following epicentral distances:—Calcutta 493 Kms., Agra 805 Kms., Dehra Dun 902 Kms., Bombay 1,610 Kms., Mangalore 1,929 Kms., and Kodaikanal 2,026 Kms. The time-distance curves of the important phases of the principal shock are also given in Fig. 6. The development of surface waves (Fig. 3) and the general trend of the time-distance curves of the various phases suggest that the focal region of the principal shock was of shallow depth, but a reliable estimate of the actual depth from the seismograms is not possible in the absence of records close to the epicentre.

The main object of the present note is to point out that a preliminary examination of the available Indian seismograms does not suggest that the focal region of the principal shock of January 15 was very abnormal in extent. A detailed discussion of the seismograms of the principal shock and its after-shocks will be published elsewhere.

### Some Foreign Weeds and their Distribution in India and Burma.

By K. Biswas,

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MR. A. C. JOSHI'S note on the occurrence of *Croton sparsiflorus* in the United Provinces, published in *Current Science*, 2, 344, 1934,<sup>6</sup> prompts me to put down my observations regarding the distribution of some of the common harmful exotic weeds established in this country.

The interesting study of migration of foreign plants dates from a very early period, as far back as 1786, the date of the foundation of the Royal Botanic Garden, Calcutta (the then Hon. East India Company's Botanical Garden, Calcutta) and the Serampur Botanical Garden—generally known as Dr. Carey's Garden. During this time Roxburgh, "the father of Indian Botany", and Dr. Carey of great fame started cultivating in their gardens at Sibpur and Serampur, various species of foreign and indigenous plants with a view to have a suitable botanical garden of scientific value near Calcutta. This work was followed by such eminent botanists as Voigt, Wallich, Griffith, Buchanan, Hamilton, Falconer, Thomson, Ander-

son, Clarke, King, Gamble and Prain. Thus by the time Brühl published his *Recent Plant Immigrants* in 1908,<sup>3</sup> the Botanic Garden at Sibpur during the course of one hundred and twenty-two years, formed a centre of distribution of a large percentage of plants at present found in the neighbourhood of Calcutta in the district of Hooghli-Howrah and the 24 Parganas. Coastal invasion of foreign plants either by sea or by ships calling at the various ports of this country may be considered another source of migration of foreign plants. Exchange relation in plants with different gardens and introduction of seeds by private individuals may be other important factors of local migration of plants. The problem of distribution and dispersal of plants is too large to be discussed here. I refer the reader to the book entitled *The Dispersal of Plants throughout the World* by H. N. Ridley, 1930,<sup>10</sup> for sufficient information on this subject. The authors of the local floras such as Prain, Cooke, Gamble, Brandis, Duthie,

Haines and others have mentioned in their works some of the plant intruders of this country. Kashyap has recorded some of the foreign plants in his article on "Notes on some foreign plants which have recently established themselves about Lahore." "In the list of species and genera of Indian Phanerogams not included in Sir J. D. Hooker's *Flora of British India*,"<sup>5</sup> Calder, Narayanaswami and Ramaswami have compiled in alphabetical order, the names of species published up to 1924 which were not noted in *Flora of British India*. This work covers 157 pages. Recent writers such as Brühl, Blatter, Parker, Kanjilal (Senior and Junior) Sabnis, Fyson, Parkinson, Mayuranathan, Tadulingam and the writer and others have also reported in their works some of the foreign plants. There has become, as the author experiences during his association with the herbarium of the Royal Botanic Garden, Calcutta, a large accumulation of foreign specimens. A comprehensive list of these 'Plant Immigrants' will be published in course of time.

Some of the most common foreign weeds chiefly hailing from tropical America have of late been almost terrestrial pest in different parts of the country. These weeds cover sometimes acres after acres of field or open places, and miles and miles along the railway lines forming more or less a pure association of their own. *Eupatorium odoratum* encroaches upon outskirts of the tropical evergreen forests in South Burma and penetrates into the Terai of the Eastern Himalayas sometimes struggling to replace the characteristic Savanah formation of this region. Some again spread rapidly in the plains and ascend with equal vigour to the hills sometimes reaching even an elevation of 10,000 ft. These plants are mostly perennial and may be called in general weeds including herbs, undershrubs and climbers. Some of them flower throughout the year and some in spring from January to February. Fruits ripen before the rains from March to April. Some of the species more or less dry up in the hot weather. The climax of growth of most of these species reaches within two to three months after the rains—say from September to December. The rapid spread of *Eichhornia speciosa*, *Croton sparsiflorus*, *Eupatorium odoratum* and *Lantana camara* within a fairly short period has become such a menace to cultivation that questions were raised in the local Legislative Councils to find out means

for their control and eradication. The question of eradication of *Eichhornia speciosa* (water hyacinth) is still uppermost in our mind. The writer, as hinted in his paper entitled "Role of Aquatic Vegetation in the biology of Indian waters"<sup>2</sup> is of opinion that the eradication of water hyacinth, as also the other terrestrial species, can alone be done by mechanical means and organised labour. I have studied the question of eradication of water hyacinth since it was tackled by Dr. P. Brühl from 1920 onwards. I have had the opportunity of visiting different affected areas in India and Burma. I am convinced that there is no royal road to eradicate this pest save and except by mechanical means. Utilisation of water hyacinth compost as manure is, I believe, not so very tempting to the agriculturists as to induce them to apply their whole-hearted effort for eradication. Manufacture of alcohol from water hyacinth on a commercial scale is rather doubtful, but if it proves successful by the attempt of Dr. H. K. Sen, it might be a tempting offer. In any case in this country under the present circumstances, it appears to me that a certain amount of forced labour or legislation might have, in the beginning, desirable effect to stir up the landholders to take up the work in right earnest. The prospect of utilising water hyacinth as manure, potassium salt, alcohol and other by-products might also encourage educated people and zemindars of the affected areas to influence the tenants for exerting their manual labour to the full extent for the eradication of this pest which day by day is leading them to heavy financial losses.

The control of terrestrial pest is not so very complicated, as it requires keen watch in uprooting the plant before the fruiting period. In this way after three or four years weeding they will be quite under control. In the forest areas careful burning of the weeds in proper time will have considerable effect in checking their growth. Thus by careful weeding the author finds large plantations, gardens and estates are kept free from growth of undesirable weeds. In this country edaphic and climatic conditions, vast areas, finance and other labour factors are not favourable to the use of spray and chemicals.

The American plants seem to have particular liking for the Indian soil, so that once they can set foot on any part of India they spread like wild fire in no time. Of such

may be mentioned—the Euphorbiaceous South American *Croton sparsiflorus* which Prain records as occurring in the Royal Botanic Garden in 1904. This alien species was evidently, as Mohr refers in his *Plant Life of Alabama* in 1901, was introduced in ballast and found its way to India via Malay Peninsula, South Burma and Aracan sea coast. Both Brühl and Joshi remark that this plant favours riverside and water courses. The writer thinks that this plant first settles down along the river-side, water courses of various sorts and even along the edges of ditches. This is evidently due to its innumerable seeds having been washed down by rainwater are finally distributed by the current of rivers. The seeds thus carried by water are stranded along the margins of watercourses or open chasms of rivers and canals and grow there under suitable conditions. In this way the plants are securely placed in their new habitat, and after first fruiting period the cocci are scattered and the area of the spread of this plant increases in mathematical proportion. Its access to Benares is very likely by boats plying in the river Ganges or by human agency or by trains running from Bengal to the Upper Gangetic plain. The writer during his recent tour followed this species down to South Burma where it might have reached by the sea along the Aracan sea coast. Its luxuriant growth in masses forming pure association in open fields in some parts of Bengal sometimes lends a touch to the landscape. It spreads right up to the foot of the Himalayas in Northern Bengal. In South India it has been observed by Mr. V. Narayana-swami that this plant spreads particularly along the Railway lines and embankments and extends up to the foot of the Nilgiri Hills. It is not very common in Bihar and Orissa. It has become a veritable pest in Bengal and it is high time that steps should be taken for its eradication, as its growth increases not only the labour charges but also reduces the fertility of the soil. The species appears to favour moist tropical areas and slightly alkaline soil conditions. The plant is not liked by cattle. *Scoparia dulcis*, another tropical American erect small medicinal herb, unknown in Roxburgh's time, is nowadays common everywhere and extends even up to the Terai region chiefly following the open roads and pathways. This plant belongs to the family of Scrophularinæ. *Eupatorium odoratum*, a Compositaceous plant, known by the local

people as "Assam lata," is a tall scandent undershrub introduced after Roxburgh's time from Jamaica, West Indies. Hooker reports its occurrence in Assam, S. Burma and Malay Peninsula. This species is at present wild everywhere in the eastern and southern parts of the Indian Empire. This is the most common plant along the railway lines, in village shrubberies and fallow lands in Assam, Bengal, Southern India and Burma. In Assam, especially along the borders of Sylhet hills and the bases of the Naga Hill ranges, it becomes such a dominant species that it may be called *Eupatorium odoratum* association. Such association is not infrequently met with in the secondary formation of the tropical rain forests of S. Burma. Predominance of its growth is also noticed along the base of the Sikkim, Bhutan, the Garo Hills, Khasia and Jaintia hill ranges and Manipur in the east and Madhupur jungle, Mymensingh, Bengal in the west. It is very likely that the plant might have been introduced from the West Indies to India and Burma by seeds confined to the ballast heaps of Cargo boats calling at Singapore. From the Malayan port the plant found its way into Lower Burma. The line of distribution gradually extends further inland and then bifurcating—one branch extending up the duars of N. Bengal and Assam ranges where it finds ideal condition of growth; and the other to the west Bengal, via Chittagong Hill Tracts, Hill Tipperah, Dacca and Mymensingh. It is now making attempts to encroach upon the boundaries of Bihar and further north-west towards upper Gangetic Plain. It rapidly replaces the indigenous shrubby and herbaceous association.

The herb *Ageratum conyzoides* Linn., sometimes known as 'Goat weed' belonging to the family of Compositæ, is a native of tropical America. It follows more or less the same path as that of *E. odoratum*. The plant is a small gregarious herb spreading nearly all over the country except very dry parts—ascends from the sea-level to 8,000 ft. or more in altitude in the eastern Himalayas. The species is abundant in Ceylon too. This species is considered to have been introduced by man to the different parts of the world. *Mikania scandens*, another tropical American plant of the family of Compositæ, unknown in Voigt's time, has of late been a widespread climber. The eradication of this climber is difficult due to its vegetative propagation by roots developing from the



nodes and to its profuse growth of flower heads. Its occurrence on shrubs, trees, bushes and marshy areas even over-choked up tanks, is a familiar sight in the Lower Gangetic and Assam and Burma plains. Hooker reports its occurrence in Assam, Burma and Malay Peninsula. The spread of this climber may carefully be watched by the neighbouring provinces and steps should be taken to prevent its entrance. The Central American *Lantana camara* of the family of Verbinaceæ commonly met with in this province in village shrubberies is a veritable terrestrial pest in the Deccan peninsula and the Carnatic. It is reported to occur in the Lower hill forests of the E. and the N.-W. Himalayas, Bengal, Assam, Burma and the Andamans as well. The plant is seriously interfering with cultivation and forest operation and its eradication has attracted attention of local people. Of recent years the South American species, *Heliotropium curasavicum*, recorded from the Madras Presidency, though grown in Serampore was not mentioned by Prain in his *Bengal Plants*<sup>5</sup> and in his paper on the "Vegetation of the Districts of Hooghly, Howrah and 24 Parganas."<sup>6</sup> Brühl mentions it as 'domesticated in Serampore'. The writer finds it spreading over moist areas of Salt-lakes near Calcutta. It is gradually approaching the town covering sometimes in dense masses large plots of lands. But *Suaeda maritima*, as noted in my paper on the "Flora of salt lakes, Calcutta"<sup>7</sup> gains the upper hand in the struggle for existence between the two species in the salt-lakes proper. The Tropical American Solanaceous plant *Solanum glaucum* is an interesting slender rather tall undershrub with beautiful glaucous linear acute leaves and pale bluish flowers. It has been found growing recently in the neighbourhood of Sundribuns. It has been noticed lately proceeding further inland in the 24 Parganas not very far from Calcutta. It was cultivated in the Royal Botanic Garden in 1899. *Argemone Mexicana*, a native of Mexico, as noted by Joshi, is a common roadside and field weed growing everywhere. This Mexican poppy of the family of Papaveraceæ has already been mentioned in 1875 by Hooker and Thomson in the *Flora of British India*—as "naturalised throughout India". The seeds of this species are

disseminated by rain-wash. *Opuntia dillenii*, another American cactus, is confined to the sandy areas especially along the seacoasts of Orissa and drier parts of India, where the spread of this species is so much felt that attempts have been made by the Agricultural Department to kill the plants by means of (cochineal) insects. Dr. H. Pruthi of the Zoological Survey of India has been kind enough to inform me that two cochineal insects, *Dactylopius tomentosus* and *D. indicus* are useful for the eradication of prickly pear (*Opuntia* Sp.). The Loktak lake of Manipur and other marshy areas in Assam are infested with *Polygonum orientale* which is now being replaced by *Eichhornia speciosa*. The representatives of Gramineæ are well known for their long range of distribution and adaptability. I mention here *Anastrophus compressus* only, recorded from this country for the first time by Brühl occurring in the Royal Botanic Garden.<sup>8</sup> Although this plant has been spreading rapidly on the grounds of the Botanic Garden, especially in shady areas, and observed to occur in and about Ballygunge maidan, its spread is not noticed during these years to be so fast as that of its other kindreds.

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### Brackish Water Animals of the Gangetic Delta.

By Dr. Sunder Lal Hora, D.Sc., F.R.S.E., F.L.S., F.Z.S., F.A.S.B.,  
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ZOOLOGISTS in Calcutta have been often attracted by the interesting fauna of the Salt Lakes and the Deltaic region of the Ganges. Sixty-five years ago Stoliczka (1869) started researches on these animals which have been followed by Alcock, Annandale, Kemp, Sewell and other past and present officers of the Zoological Survey of India. The results of the researches of these workers are embodied in a series of short papers published in different journals. In the last number of the *Records of the Indian Museum* (36, pt. i, pp. 45-121, 12 figs., March 1934), Lt.-Col. R. B. S. Sewell, in his article entitled "A Study of the Fauna of the Salt Lakes, Calcutta", has not only brought together the results of all these researches, but has amplified them considerably by a study of the fauna both in the field and in the laboratory. Though Col. Sewell has dealt mainly with the plankton, with special reference to the Copepoda, in his general treatment of the subject he deals also with the wealth of information that has accumulated regarding other groups of animals.

The geography of the area investigated by the Calcutta zoologists is fully described and it is indicated that for several years past there has been a steady change in the conditions existing in and the general character of some of the rivers in Lower Bengal, and that these changes have had a profound effect on the Salt Lakes and the associated streams and thus indirectly on the general character of the fauna of certain areas. The waters of the Salt Lakes even in 1928 used to be fairly brackish (Salinity 9.60 per mille in February 1928) whereas now they are almost fresh (Salinity 2.20 per mille in February 1933). In consequence, a considerable change in the plankton fauna has been indicated by Sewell.

It is rightly pointed out that "The chief zoological interest in a brackish-water area such as that under consideration lies in the fact that it forms one of the main highways by which certain constituent elements of the marine fauna of the Indian Seas can encroach on and finally establish themselves in fresh water." The main physical factors that the animals have to contend with during the course of migration are: (i) change

in salinity, (ii) soft and shifting substratum, (iii) density of silt suspended in water, and (iv) for certain animal associations of this region, periodic desiccation due to tides and other causes. The biological factor, which possibly supplies a stimulus for migration, is the great increase in the available food supply that is found in the region of such estuaries. "The flow of the river brings down with it great quantities of vegetable debris and detritus, that are available as a source of food, and at the same time large quantities of nutrient salts, derived from the land, and poured out into the sea, result in a very large increase in the Diatom flora, that in turn also serves as a food supply for the smaller marine organisms." As there is a great variety of habitats and 'niches' in this environment, the fauna is fairly rich; but it has to be remembered that this environment is full of struggle and strife and demands a great deal of physiological and structural adaptability on the part of the animals inhabiting it. Structural modifications are mainly noticeable in the fish and Decapod crustacea, while striking changes in the physiology and general habits of all animals must have taken place as a measure of adaptation to the varying needs of this environment.

Lists of species in the various animal groups that are known to occur in the Gangetic Delta are given and though these lists are by no means complete, they provide valuable data for further work. A list of stations investigated and the salinity of water at each locality are given. Several new species of Copepods are described and there is an interesting section devoted to the origin of and changes in the Copepod fauna of the Delta. The estuarine fauna, according to Sewell, consists of three elements, marine, relict and freshwater. The majority of the animals that are found in this habitat are, no doubt, derived from the sea and with the exception of fish and other larger animals, specially crabs and prawns, the smaller animals seem to have been brought from the sea to the deltaic region, either as adults or as larvæ, by the action of the tides. Similarly during floods, freshwater animals are carried to these regions and gradually become acclimatised to higher salinity. Moreover,

"In times past, there can be but little doubt, that this region was actually a part of the Bay of Bengal and that with the gradual extension of the Delta seawards the water of the rivers and lakes gradually became less and less salt, though the actual process must have been extremely slow. A certain number of marine species that had established themselves within the area during the early stages of the formation of the Delta would doubtless be able to acclimatise themselves to the gradually changing conditions and thus equally be able to persist in

their original habitat and form a relict fauna."

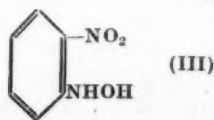
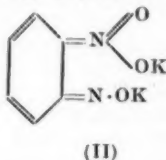
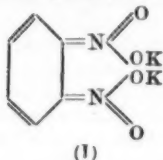
The paper as a whole is a most striking and important contribution, and the author's treatment of the general biological problems connected with this fauna is very clear and stimulating. In a country like India, where there are several estuarine regions, the paper should prove a boon to the general biologist, especially as it contains a big list of useful references. Col. Sewell deserves to be heartily congratulated on this magnificent piece of work.

### Letters to the Editor.

#### Truhaut's Colour Reaction for Uric Acid.

QUITE recently Truhaut (*J. Pharm. Chim.*, 1933, **125**, 339) observed that many compounds having a  $\text{—CO—}$  grouping in the molecule gave a colour reaction with *m*-dinitrobenzene in alkaline solution. Uric acid is stated to give a stable and characteristic violet colour, when to a warmed mixture of 1 c.c. of 1% *m*-dinitrobenzene (in alcohol) and 2 c.c. of 10% aqueous sodium hydroxide solution, 0.1 g. of uric acid is added. As a matter of fact, a specimen of "pure" *m*-dinitrobenzene (supplied by Dr. Fraenkel and Dr. Landau of Berlin) gave a positive reaction under the above conditions. No colour reaction was, however, observed after this sample had been repeatedly crystallised from absolute alcohol. *o*-Dinitrobenzene, on the other hand, produced a violet colour even in very minute quantities. It is therefore believed that the sample of *m*-dinitrobenzene used by Truhaut was not free from *o*-dinitrobenzene and hence the colour.

The violet colour may be due to the formation of a quinonoid salt (I) (Meisenheimer, *Ber.*, 1903, **36**, 4174), or (II). Prof.



W. Lipschitz (private communication) on the other hand prefers the structure (III).

P. K. BOSE.

Chemistry Department,  
University of Calcutta.

March 8, 1934.

#### A Note on the Course of Crystallisation of a Basaltic Magma.

In the study of the order of crystallisation of the different minerals in a cooling magma, according to Dr. Holmes<sup>1</sup> "the real order of formation is most likely to be ascertained from comparative observations on a series of rocks of similar chemical composition which have been quenched at different stages in their cooling history." A very good opportunity for such a study is afforded by an olivine dolerite dyke, occurring near Mysore. This dyke is about 65 feet in width and a good section is exposed in a channel cutting across the dyke. The dyke shows gradual textural changes from a porphyritic basalt at the selvages in contact with the gneissic country rock—to a coarse gabbro with sub-ophitic texture in the centre. The different stages of cooling history are thus clearly revealed, and from a microscopic examination of a series of graded sections from the margin to the centre, it is possible to study the order in which the minerals appeared and the order in which their crystallisation ceased.

<sup>1</sup> A. Holmes, *Petrographic Methods and Calculations*, 1930, pp. 350-351.

Starting from the margin, the early start of the olivine in the crystallisation of the magma is indicated by its occurrence in the selvage rock, as phenocrysts in a groundmass of minute grains of hypidiomorphic pyroxene with interstitial felspar. The study of the groundmass further suggests that the pyroxene started crystallising earlier than the plagioclase. As we approach the centre, the rock becomes a fine grained dolerite with ophitic to sub-ophitic texture. Both the plagioclase and the pyroxene are idiomorphic and the pyroxene often shows evidences of reaction with the magma as revealed by the presence of corroded borders and of reaction minerals like biotite. The material from the centre of the dyke is a coarse gabbro with sub-ophitic texture. The continued corrosion of the pyroxene has effaced any tendency in it towards idiomorphism. The moulding of the pyroxene round the plagioclase suggests that the pyroxene had a longer range of crystallisation than the felspar.

It would thus appear that these observations of ours are distinctly in support of the views recently expressed by Fenner<sup>2</sup> regarding the interpretation of the ophitic texture.

A full account of the rocks including chemical analyses will shortly be published elsewhere.

S. R. NARAYANA RAO.  
K. SRIPADA RAO.

Department of Geology,  
Intermediate College,  
Mysore.

March 12, 1934.

#### Sex Control in Papaya.

PAPITA *Carica papaya* is a dieceous tree and about half of the trees are male and half female. Various attempts have been made to eliminate the male papaya and to secure a type which will produce only female plants. Normally flowers in the male are small and are borne in long branching panicles 2 to 3 ft. in length. The flowers in the female tree on the other hand are large and almost sessile and are borne along the side of the trunk in the axils of the leaves.

The fruit is of great commercial value and it is a constant source of trouble to the grower to see about half of his papaya trees develop male flowers. It has been found

possible to change the sex by mutilation. At the Hawaii Experiment Station 22 perfectly sterile staminate papaya trees were beheaded. When the new growth appeared on those trees it was found that the trees had become strictly female trees bearing large fruit.<sup>1</sup>

From the Botanical Garden at Jaswant College, Jodhpur, I supplied some papaya seedlings to Mr. G. N. Singhal, Head Master, Darbar High School, Jodhpur. After about a year he complained of all of them turning out to be male. I suggested beheading. Accordingly the plants were beheaded to remove the cluster of leaves at the top, so that no axillary male shoots may develop. This distance is about a foot from the apex. Two new shoots appeared in two cases and only one was kept in each case. Only one shoot developed in each of the other two.

All the four beheaded have developed into strictly female trees. One of them is bearing large fruits. The other is bearing female flowers. The third was killed after it had borne female flowers. The fourth has also produced female flowers.

Beheading according to some observers never produces the desired result. It is advisable, however, to try beheading before cutting the male papaya.

S. SARUP.

Jaswant College,  
Jodhpur,  
March 12, 1934.

#### A Note on the Life History of *Sagittaria guayanensis* H.B.K.

FOLLOWING my observations on the life history of *Limnophyton obtusifolium* Miq. (*Current Science*, 2, p. 12), I have been able to investigate *Sagittaria guayanensis* H.B.K. another member of the *Alismaceae* collected from Bharatpur. The following is a brief summary of this work.

There is a many-celled archesporium in the anther. The tapetum, the endothecium and a single middle layer are formed as usual, by the divisions of the primary parietal layer. The tapetum gives rise to a periplasmodium. The middle layer degenerates very early, even before the mother cells have finished the reduction divisions.

The divisions are successive and the resulting tetrads are usually iso-bilateral.

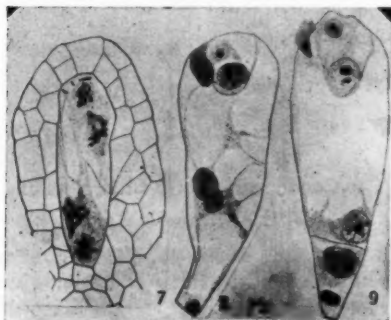
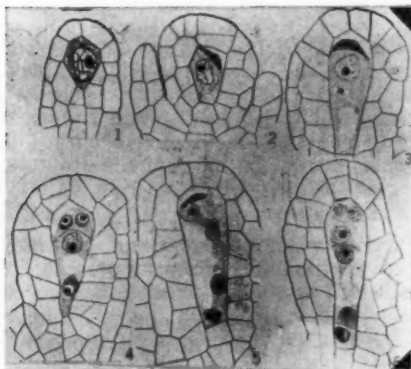
<sup>1</sup> Wilcox, E. V., *Tropical Agriculture*, p. 120, 1916. Appleton & Co., N. York.

<sup>2</sup> C. N. Fenner, *Journ. Geol.*, 34, 1926, p. 756.



The microspore nucleus divides giving rise to the tube and generative cells. After some time the nuclei lie free in the cytoplasm. The generative nucleus divides in the pollen grain to form two spherical nuclei, which later on become spindle-shaped. Sometimes, these male nuclei show a clear area around them, but I could not make out a definite cytoplasmic layer round them.

Usually there is a single hypodermal archesporial cell in the nucellus (Fig. 1), but sometimes there are two lying side by side or one above the other. In one case there



was an indication of the presence of three archesporial cells in the same nucellus.

The archesporial cell directly functions as the megaspore mother cell which divides into two cells of which the lower produces the embryo sac. The upper degenerates early (Fig. 2) but in rare cases its nucleus may divide into two before degeneration (Fig. 4).

The nucleus of the lower cell undergoes two divisions to produce a four-nucleate embryo sac (Figs. 3-5). After this stage, only the two micropylar nuclei divide in the

majority of cases and a six-nucleate embryo sac is organised as in *Limnophyton obtusifolium* and the other *Alismaceae* investigated by Dahlgren<sup>1</sup> (Fig. 6). Less frequently one or both of the chalazal nuclei may also divide forming a 7- or 8-nucleate embryo sac respectively (Fig. 7). Such a variation in the number of nuclei has also been reported by Frisendahl<sup>2</sup> in *Elatine*. Evanescent cell plates may occasionally appear on the spindles of the embryo sac (Fig. 6).

All stages of double fertilisation have been seen. The pollen tube as it enters the embryo sac always disorganises one of the synergids. Generally the two polar nuclei and one male nucleus fuse simultaneously (Fig. 8). The fusion nucleus is situated in the middle of the embryo sac a little nearer the chalazal end.

The endosperm is of the Helobiales type. A definite wall is formed after the first division of the primary endosperm nucleus (Fig. 9), as reported by Schaffner<sup>3</sup> on *Sagittaria latifolia*.

The embryo is of the *Alisma*-type.

I am greatly indebted to Dr. P. Maheshwari for his kind help and useful suggestions and criticisms.

BRIJ MOHAN JOHRI.

Department of Botany,  
Agra College,  
Agra (India),  
March 24, 1934.

#### The Band Systems of CdF.

THE spectrum of the molecule CdF as produced in the arc shows a number of band heads which are classified into two systems. One of these, the yellow-green, lies between 5300 and 5550 Å.U. This system is degraded towards longer wavelengths. The other, the orange system, lies between 6025 and 6300 Å.U. and is degraded towards the shorter wavelengths. The equations representing the two systems are:

<sup>1</sup> Dahlgren, K. V. O., "Die Embryologie Einiger Alismataceen," *Svensk Bot. Tidskr.*, **22**, 1-17, 1928.

<sup>2</sup> Frisendahl, A., "Über die Entwicklung chasmogam kleistogamer Blüten bei der Gattung *Elatine*," *Meddelanden från Göteborgs bot. trädg.*, **3**, 99-142, 1927.

<sup>3</sup> Schaffner, J. H., "Contribution to the life history of *Sagittaria variabilis* (latifolia)," *Bot. Gaz.*, **23**, 252-273, 1897.

(1) Yellow-green  $R_2$  heads :— $\nu_{\text{heads}} =$ 

$$18871.0 + [672.38 (v' + \frac{1}{2}) - 5.14 (v' + \frac{1}{2})^2] \\ - [694.29 (v'' + \frac{1}{2}) - 4.96 (v'' + \frac{1}{2})^2].$$

(2) Orange  $Q_2$  heads :— $\nu_{\text{heads}} =$ 

$$16558.3 + [734.36 (v' + \frac{1}{2}) - 5.74 (v' + \frac{1}{2})^2] \\ - [698.34 (v'' + \frac{1}{2}) - 5.36 (v'' + \frac{1}{2})^2].$$

The yellow-green system is evidently due to the transition  ${}^2\Sigma \rightarrow {}^2\Sigma$  and the orange to  ${}^2\pi \rightarrow {}^2\Sigma$ . The final level  ${}^2\Sigma$  of both the systems appears to be the same though the frequencies of vibration and the anharmonic factors are slightly different. This discrepancy which has also been observed in the case of alkaline earth halides is probably due as Johnson\* and Harvey† have pointed out, to the heads being formed at large  $J$  values and the distance  $\nu_h - \nu_0$  being not constant throughout the system. The dissociation energies derived from these equations favour the following interpretation of the structure of the molecule :—

$\text{Cd } (5s \ 5p \ {}^3P) + \text{F } (2p^5 \ {}^2P) = \text{CdF } {}^2\Sigma$  ground level.

$\text{Cd } (5s \ 6s \ {}^3S) + \text{F } (2p^5 \ {}^2P) = \text{CdF } {}^2\pi$  and  ${}^2\Sigma$  excited.

Details will be published elsewhere.

R. K. ASUNDI.  
R. SAMUEL.  
M. ZAKI UDDIN.

Department of Physics,  
Muslim University,  
Aligarh,  
April 10, 1934.

### On the Laws of Spreading of Liquid Drops on Filter Paper.

A LARGE number of experiments with various organic liquids such as alcohols, etc., and water has been recently made in this laboratory to discover the law or laws which govern the spreading of a single drop of the liquid on a filter paper. To prevent the effect of evaporation of the spreading drop, observations are made in a closed chamber kept saturated with the vapour of the liquid.

The liquids, so far studied, show that the velocity of spreading dies down according to two distinct exponential laws which may be put in the forms :—

\* *Proc. Roy. Soc.*, **A 122**, p. 161 (1929).

† *Proc. Roy. Soc.*, **A 133**, p. 336 (1931).

$$V_d = V_0 e^{-\lambda_1 d} \quad \dots \quad (1)$$

$$v_d = v_0 e^{-\lambda_2 d} \quad \dots \quad (2)$$

The second law becomes operative as soon as the influence of the first has disappeared.

A dimensional analysis of  $\lambda_1$  and  $\lambda_2$  leads to the following results, namely,

$$\lambda_1 = \frac{C_1}{A} \cdot \frac{(MT)^{1/2}}{\eta} \quad \text{and} \quad \lambda_2 = \frac{C_2}{v_c} \cdot \left( \frac{T}{M} \right)^{1/2}$$

where  $M$  is the mass of the drop;  $T$  the surface tension of the liquid;  $\eta$  the coefficient of viscosity;  $C_1$  and  $C_2$  are two pure numerics and  $A$  is the area of the filter paper wetted by the liquid until equation (1) holds and  $v_c$  is the critical velocity at the distance at which transition from law (1) to law (2) takes place. The critical velocity has been found to be a very definite constant for a given pure liquid, independent of the mass of the drop taken. The results observed completely verify the laws given above.

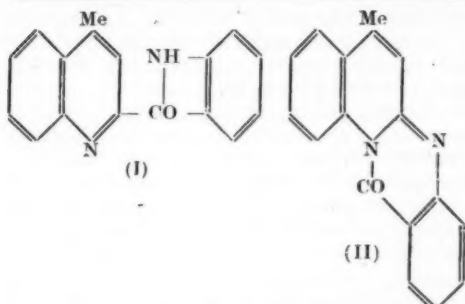
Further work on solutions of different electrolytes is in progress at present. Full details will be shortly published.

K. PROSAD.  
B. N. GHOSH.

Physics Department,  
Science College,  
Patna,  
April 13, 1934.

### The Condensation of 2-Chlorolepidine with Anthranilic Acid.

EPHRAIM (*Ber.*, 1892, **25**, 2710) condensed anthranilic acid with 2-chlorolepidine in absence of any solvent and suggested an anthranil structure (I) for the product, on the ground that the substance could be easily hydrolysed by alcoholic potash to an acid. Backeberg (*J. Chem. Soc.*, 1933, p. 390) supports this constitution without adducing fresh reasons, and finds moreover that the product is the same even when such solvents as nitrobenzene or acetic acid are employed (*cf.* E.P. 321738). Recently the present author in collaboration with Mr. D. C. Sen (*J. Chem. Soc.*, 1931, p. 2840) has studied the condensation of 2- and 4-chloroquinolines with anthranilic acid and has ascribed the general structure (II) to the products obtained



from anthranilic acid and 2-chlorolepidine. The fact, recorded by Backeberg, that 2-chlorolepidine condenses with anthranilic acid in acetic acid solution supports our view of the mechanism of condensation, inasmuch as anthranil formation does not take place easily. It is also difficult to explain the absence of any anthranil in the condensation of anthranilic acid with 4-chloroquinoline, if the views of Ephraim and of Backeberg be correct. Our arguments have already been put forth and they need not be repeated here. Incidentally it might be pointed out that 4-*o*-carboxyphenylaminoquinoline and 2-*o*-carboxyphenylaminoquinoline have been previously described by us—a fact which has apparently been overlooked by Backeberg.

P. K. BOSE.

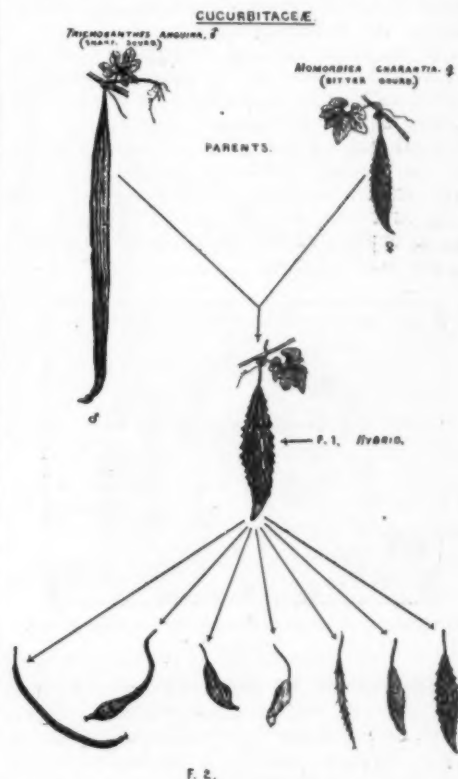
University College of Science,  
Calcutta,  
April 20, 1934.

#### Intergeneric Cross in Cucurbitaceæ.

At the instance of the Director of Agriculture, Madras, a number of both interspecific and intergeneric crosses have been attempted in cucurbitaceæ. In very many cases, there was no development of fruit.

In one case, however, that between bitter gourd (*Memordica Charantia* ♀) and snake gourd (*Trichosanthes anguina* ♂) over 50% of the artificially pollinated flowers have developed into fruit, the seed of which, when sown, germinated well and produced a normal crop. Reciprocal crosses in these have also been attempted but without success. The seed obtained was sown with over 50% germination and the tender plants were healthy even from the beginning. Except that the plants were more vigorous than the female parent, all the floral and vegetative characters of the bitter gourd

were dominant while those of the snake gourd were recessive. The  $F_1$  plants were fully fertile as the fruits which were slightly bigger in size than those of the parent contained fully developed seeds. The seed when sown in the second filial generation germinated well but a large percentage of the seedlings were washed away by floods. The surviving plants came up fairly well after a certain amount of tardy growth in the early



stages and are now bearing fruit. The  $F_2$  segregation has produced interesting combinations—there being gradations not only in form and size of fruit but also in taste. It is too early to say anything more at present and the results of detailed study will be published in due course.

S. SITARAMA PATRUDU.

P. KRISTNA MURTI.

Agricultural Research Station,  
Anakapalli.

April 20, 1934.

**Sterility of the Female Gametophyte of  
*Colocasia antiquorum*, Schott.**

*Colocasia antiquorum* is a common aroid of Bengal which grows profusely during the monsoon. It is particularly abundant on the sides of tanks and 'jhils' and also on water-logged areas. The method of propagation is chiefly vegetative. As seed formation in this plant has not been observed under natural conditions, a study of the female gametophyte was undertaken which revealed the following facts:

The archesporial cell is hypodermal in origin and functions as the megaspore mother cell. The prophase changes in the nucleus of the megaspore mother cell are quite normal. During the heterotypic metaphase a bipolar spindle is formed, but the chromosomes lie irregularly clumped in the centre and their distribution to the poles is very irregular, as shown in the accompanying photomicrograph.



Heterotypic division of the megaspore mother cell.  
× 1100

Degeneration of the megaspore mother cells is first noticed at this stage. Those which do not degenerate undergo the homeotypic division, which is characterised by the same irregularities as was observed during the reduction division. The homeotypic spindles are separated by a distinct wall. Degeneration at this stage is also sometimes observed. As a result of the homeotypic division four macrospores are produced which are arranged lineally and separated by distinct walls. Degeneration of all the macrospores at this stage in the development of the ovule is very commonly met with. The degenerated macrospores appear as dark streaks in the centre of the nucellus. Sections of fully opened flowers and flowers still older invariably show

crumpling of the ovules and the absence of the female gametophyte in the nucellus, which is composed of a few layers of cells and is bounded by the integuments.

It is interesting to note that recently Maeda<sup>1</sup> has observed irregularities in the reduction division of this plant and he believes that probably this might be the cause of sterility. A full account of the investigation will be published elsewhere.

I. BANERJI.

Botanical Laboratory,  
Calcutta University,  
April 23, 1934.

**Loss of Nitrogen from Swamp Soils.**

FOLLOWING the classical researches of Gayon and Dupetit on denitrification in sewage, a number of workers have suggested the possibility of similar changes occurring under the 'anaerobic' conditions prevalent in swamp soils. There is very little experimental evidence, however, to support such a theory: nor is denitrification, as commonly understood, likely to play any important part in swamp soils because the latter seldom contain more than traces of nitrates.

In the course of an investigation on carbon and nitrogen transformations attendant on the application of substances with different C-N ratios to swamp soils, it was observed that there was practically no loss of nitrogen during the initial stages of fermentation. There was, on the other hand, considerable production of ammonia especially from substances with narrow C-N ratios. This was followed by a period of slow nitrification when considerable loss of total nitrogen was noticed. The last observation being contrary to the previous conceptions, a series of systematic studies were carried out, following the changes in different forms of nitrogen at weekly intervals.

It was observed that (a) ammonia was generally produced at a faster rate than nitrate, so that fairly large quantities of the former tended to accumulate in the medium (Fig. I), (b) loss of total nitrogen proceeded simultaneously with the mineralisation of nitrogen, and (c) ammonia was the chief nitrogenous product among the gases evolved and accounted for the major part of the

<sup>1</sup> Maeda Yosinori, *Proc. Crop. Sc. Soc.*, 4, 1932 (Abstract from *Jap. Jr. Bot.*, 1933, 4, 3, Abst. No. 258).



nitrogen lost from the soil system (Fig. II). Further study of the conditions relating to the loss of ammonia showed that the soil reaction which had become fairly acid ( $P_n$  5.3) and contained useful amounts of free organic acids (chiefly lactic and acetic) tended to revert to that of the original soil ( $P_n$  7.6) in the later stages. The change in reaction combined with the increasing concentration of ammonia would appear to have facilitated the volatilisation of the latter.

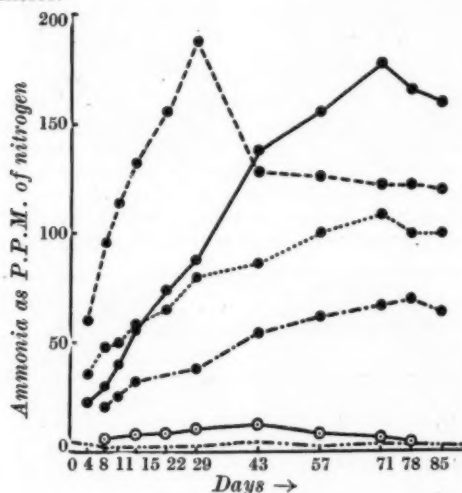


Fig. I.

Production of ammonia from equivalent amounts (in terms of nitrogen) of substances with different C-N ratios.

- |                         |                        |
|-------------------------|------------------------|
| ●—● Cyanamide           | ( $\frac{C}{N}=0.9$ )  |
| ●—● Dried blood         | ( $\frac{C}{N}=3.3$ )  |
| ●—● Urea                | ( $\frac{C}{N}=0.4$ )  |
| ●—● Hongay leaf         | ( $\frac{C}{N}=13.8$ ) |
| ○—○ Farmyard manure     | ( $\frac{C}{N}=9.2$ )  |
| --- Control (untreated) | ( $\frac{C}{N}=10.0$ ) |

Parallel studies conducted under dry soil conditions showed that similar loss by volatilisation of ammonia also occurred in such cases (Fig. II). The quantities thus lost were, however, generally less than those observed under swamp soil conditions.

Further work is in progress to determine the extent to which loss of ammonia by volatilisation occurs in presence of the growing plant. Attempts are also being made to standardise the conditions for the addition of different organic manures so

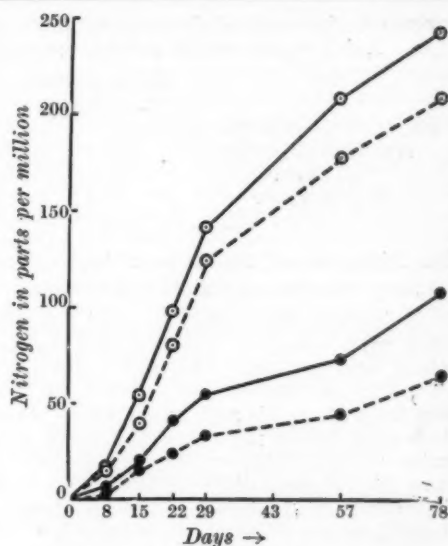


Fig. II.

Loss of total nitrogen and volatilisation of ammonia.

- |  |
|--|
| ●—● Total nitrogen lost under dry soil conditions        |
| ○—○ " " " " swamp " "                                    |
| ●—● Ammonia (as nitrogen) lost under dry soil conditions |
| ○—○ " " " " swamp " "                                    |

that while mineralisation of nitrogen proceeds unhampered, the resulting products would be retained in the soil system and become available when required by the growing plant.

A. SREENIVASAN.  
V. SUBRAHMANYAN.

Department of Biochemistry,  
Indian Institute of Science,  
Bangalore,  
May 4, 1934.

#### Absorption Spectrum of $SCl_2$ .

THE absorption spectrum of  $SCl_2$  vapour has been studied under different conditions. It shows at first a continuous absorption in the violet region at about 4100 A.U. Between 3400 and 2750 A.U. a well-developed band system appears and then two more continuous absorption regions between 2600 and 2400 A.U. and from 2280 till the limit of the transmissivity of the quartz apparatus have been observed. The spectrum and also the process of primary dissociation

appears to be quite different from that of  $\text{Cl}_2\text{O}$ . A full report will be given elsewhere.

R. K. ASUNDI.  
R. SAMUEL.

Department of Physics,  
Muslim University,  
Aligarh.  
May 5, 1934.

#### The Distances of the Closest Approach of Atoms of Rubidium, Caesium and Barium.

It is known that rubidium and caesium react with water at the ordinary temperature and so also barium.\* Therefore according to the author's rule† for the reactivity of metals with water which states that only those metals would react with water at the ordinary temperature which have the distances of the closest approach of their atoms above 3.00 Å, it seems that all these three metals would have values, which

are not available, for the distances of the closest approach of their atoms above 3.00 Å.

This view, it may be noted, is confirmed by the calculation of the distances of the closest approach of atoms of these elements with the help of the author's formula‡ which has proved helpful in rendering some explanation of the formation of amalgams with mercury§ and has given atomic approach values agreeing closely with the experimental ones in nearly a dozen (eleven) elements.

The formula may be represented by

$$D = \frac{P}{V_i \times d \cdot K/V}$$

where D is the distance of the closest approach of atoms of the elements in question, P its parachor;  $d$ , its atomic diameter;  $V_i$ , its ionisation potential and K, a constant having the value 1.58. The calculated atomic approach values which this formula has given is indicated below:

Element	Parachor	Atomic Diameter	Ionisation Potential	Valency	K/V	Closest approach of atoms	
						D <sub>calc.</sub>	D <sub>found</sub>
Rubidium .. ..	130	3.38¶	4.16††	1	1.58	4.56	—
Caesium .. ..	150	3.36¶	3.88††	1	1.58	5.7	—
Barium .. ..	160	4.20**	5.19††	2	0.79	6.57	—

It will be evident from the above table that in the case of all the three elements the calculated values for the distances of the closest approach of their atoms are above 3.00 Å which confirms their ability to react with water at the ordinary temperature. Further, it may be pointed out, since the formula has given values which agree well with experimental ones in a good number of cases and since the values obtained in the present cases are in conformity with the behaviour of these elements with respect to water, the calculated values may

seem to represent the experimental ones for which no distinctive data appears to be available.

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#### On the Development of the dorsal-arcualia, zygosphenes and zygantrum in the Vertebral Column of Snakes.

PREVIOUS investigators<sup>1 and 3</sup> on the development of the vertebral column of snakes,

\* Mathiessen, *Journ. Chem. Soc.*, 8, 204, 1856; Davy, *Phil. Trans.*, 98, 1, 333, 1808.

† Sen, *Nature*, 129, 585, 1932.

‡ Sen, *Zeit. Anorg. Chem.*, 212, 410, 1933.

§ Sen, *Chemical News*, 145, 93, 1932.

¶ Sugden's *Parachor & Valency*, p. 181.

† Lorenz, *Zeit. Phys. Chem.*, 73, 253, 1910.

\*\* Bragg, *Phil. Mag.*, 6, 40, 169, 1920.

†† Taylor, *A Treatise on Physical Chemistry*. (New Ed.), II, 1203.

<sup>1</sup> Brünauer, V. E., *Arb. Zool. Inst. Wien.*, XVIII, pp. 1-24, 1908-10.

<sup>2</sup> Mookerjee, H. K., *Phil. Trans. Roy. Soc., B*, 218, pp. 415-446, 1930.

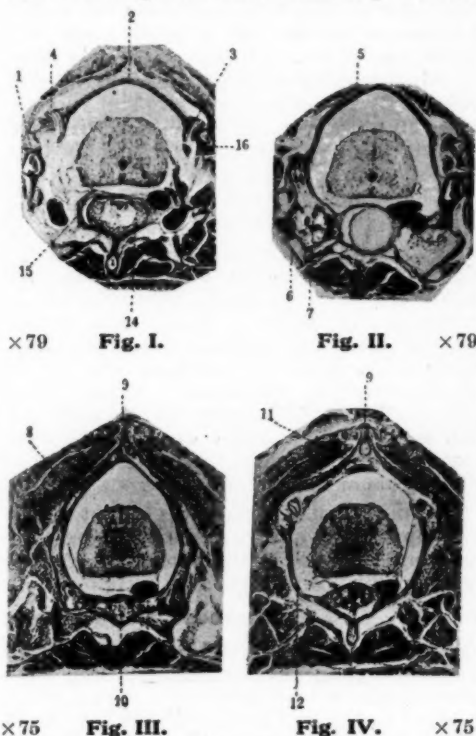
<sup>3</sup> Schauinsland, H., *Handbuch der vergl. u. experim. Entwicklungslehre der Wirbeltiere*. von Oskar Hertwig, 3, pp. 339-572, 1906.

(In this paper the list of all the previous papers could be found.)

have stated that the dorsal-arcualia are formed from the basidorsals of either side which eventually meet at the mid-dorsal line to complete the arch. Basidorsals start as membranous structure, then become cartilaginous and ultimately become

are thinner in cross-section than the basidorsals.

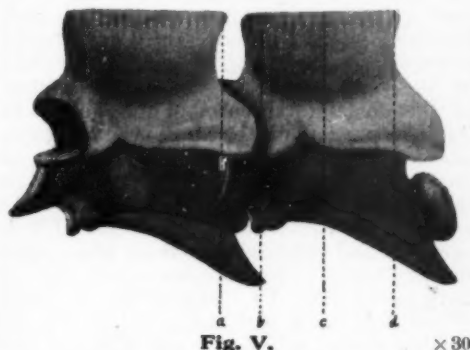
Likewise in the vertebral column of snakes we get the anterior and posterior connective tissue arches which are also thinner than the basidorsals in cross-section, and the two limbs of each arch stand at right-angles to the centrum and are not round like the basidorsals, so that the latter bulge out more on the sides over the spinal cord than the connective tissue arches (Figs. II and IV). In *Urodela* there are two fibrous layers at the intervertebral regions which are connected with the prezygapophyses and the joints of the centrum at the bottom, to allow flexibility of the vertebral column.



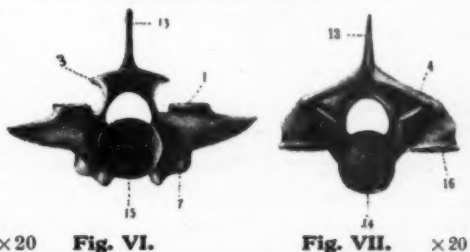
**Figs. I-IV.** Serial transverse sections through different regions of a trunk vertebra of *Tropidonotus stolicus* at 12 cm.

1. Prezygapophysis; 2. Part of the anterior connective tissue arch; 3. Zygosphenes; 4. Zygantrum; 5. Anterior connective tissue arch; 6. Rib; 7. Rib-bearing process; 8. Basidorsal (with marrow cavity); 9. Supradorsal; 10. Centrum; 11. Trace of connective tissue arch; 12. Posterior connective tissue arch; 13. Neural spine; 14. Condyle of the vertebra; 15. Socket of the vertebra; 16. Postzygapophysis.

osseous; but we have found a different story altogether. One of us<sup>2</sup> has shown that in the vertebral column of *Urodela*, corresponding to each vertebra basidorsals are situated at the middle region of the centrum and at the anterior and the posterior portions of it there are two connective tissue arches which without undergoing through the stage of chondrification become osseous. These anterior and posterior connective tissue arches



**Fig. V.** Side view of the two consecutive adult trunk vertebrae of *Tropidonotus stolicus*. a, b, c, d are the planes through which Figs. I to IV have passed.



**Fig. VI.** Anterior view of an adult trunk vertebra of *Tropidonotus stolicus*. **Fig. VII.** Posterior view of an adult trunk vertebra of *Tropidonotus stolicus*.

In the vertebral column of snake the anterior connective tissue arch joins with the posterior connective tissue arch of the previous vertebra, forming two points of articulation and, therefore, in a transverse section passing through the intervertebral portion two additional dorsolateral articulations are found which are called zygosphenes

and zygantum respectively, so that flexibility of the vertebral column of snake is also possible (Fig. I). The anterior and the posterior connective tissue arches together with the cartilaginous basidorsals become osseous like *Urodela*, and here also the connective tissue arches do not pass through the stage of chondrification. Another important point to be noted here is that the basidorsals of either side do not meet at the mid-dorsal line, but there is, as in *Urodela*, a third piece which should be called supradorsal (Fig. III). On the dorsolateral sides of each supradorsal in the region of the posterior end, there are two cartilaginous elements forming postzygapophyses at the intervertebral region like *Urodela*. So that a transverse section passing through the intervertebral portion shows supradorsal at the top, postzygapophyses with cut ends of prezygapophyses of the next vertebra at the dorsolateral corners and dorsal to them a portion of the anterior connective tissue arch with zygosphenes and also zygantia of the previous vertebra. For the sake of comparison we have given the side view of two consecutive adult trunk vertebrae and have marked there the planes through which the transverse sections would have passed (Fig. V). Figs. I to IV more or less correspond with the markings on the adult vertebrae. Figs. VI and VII are the anterior and posterior views of the adult trunk vertebra.

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BIMAL KUMAR CHATTERJEE.

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Calcutta,  
April 20, 1934.

#### Salt Tolerance of Plants as Induced by Pre-treatment of Seeds.

THE Homeopathic system of therapeutics rests on two main principles: (1) that 'like be cured by likes', and (2) that the remedies be administered usually in minute doses. The latter fact has a close parallel in the agricultural practice of fertilisers, where the dosages of the active ingredients added are extremely small as compared to those already present even in the poorer soils. This gave rise to the speculation, if the first principle of Homeopathy that 'like be cured by likes' could in anywise be utilised to serve some necessities of plant life.

As an initial experiment, it was proposed to try the possible application of this principle to the successful production of plants on salt lands. There was a considerable mortality of seedlings in saline soils. May be the plants otherwise healthy, developed certain fatal symptoms due to the presence of certain salt or salts in the soil. Were it so, it was held possible to save them by administering identical salts in minute doses. By the same law, if a plant already affected by the given symptoms be now sown in a saline soil, it is as probable that the salt in the soil will now prove a remedy; in other words, the salt tolerance capacity of the plant will greatly increase.

To test the correctness of these assumptions a series of laboratory experiments were conducted with wheat, *Dolichos lablab*, *Sorghum* and barley. In the first series, only the treatment of seeds was undertaken, while the treatment of seedlings and plants was left over for the second. As the saline soils in Sind contain chiefly the chloride and the sulphate of sodium, experiments were restricted in the present instance to the use of chloride of sodium only.

The method in the main was to first induce the supposed symptoms in healthy seeds, by treating them with NaCl solutions of different homeopathic concentrations (ranging from 0.35 to  $\frac{0.35}{10^{18}}$  %). The seeds so treated were sown in sand cultures at 25 per cent. moisture and containing the same salt NaCl in such percentages as are commonly found to be present in the salt lands in Sind. A study of the percentage germination in the different cases was made with the following results:—

Table showing average percentage germination of wheat seeds, treated with salt solutions of different concentrations and sown in sand cultures with and without salt.

In the sand culture	Seeds untreated	Seeds pre-treated with water only	Seeds pre-treated with solutions of various minute concentrations
No salt	100	100	100
NaCl 0.4%	65	80	100
„ 0.5%	40	57	70-90
„ 0.6%	15	20	20-75

In a pure sand culture (without any salt in it) the germination is cent. per cent.



whether the seed is treated or not. But once the salt is introduced into the culture, the germination of the seeds is affected, the larger the amounts of salt the lower being the germination.

Now where the seeds were pre-treated with salt solutions and then sown in salt lands, it is seen that for a given salt content in the culture the germination is generally better than in the controls (seed untreated). Also soaking in water alone has given a slight advantage to the seeds in germination.

It has also been found that the percentage figures of germination obtained with seeds treated to successive dilutions and sown in sands with the higher percentages of salt, viz., 0.5 and 0.6%, arrange themselves roughly into a parabolic curve when plotted against dilutions, the medial dilutions tried giving about the best results.

It is indeed interesting that the germination of wheat seeds was raised from 40 to

90% in sand with 0.5% salt and from 15 to 75% in sand with 0.6% salt, by the pre-treatment of those seeds with a solution of the same salt as was present in the sand culture, in a given concentration ( $\frac{0.35}{10^{16}}$  %).

Similar results have been obtained in all the repeated trials made to confirm the original results.

Because of the striking consistency and promise of the data the work is being continued in pot culture and on small plot scale. No claim is made that definitely 'like has been cured by likes' but it is suggested that the physiological and biochemical aspects of the phenomenon deserve a systematic inquiry.

V. A. TAMHANE.

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Sakrand.

### Propagation of Radio Waves.

By B. C. Sil, M.Sc.,

Station Engineer, Indian State Broadcasting Service, Calcutta.

AS one interested in the subject of the Propagation of Radio Waves, I have read with interest the address on the same by Prof. S. K. Mitra, President of the Mathematics and Physics Section of the last Science Congress and also the review thereof which appeared in the January issue of the *Current Science*. As I am unable to agree to some of the views expressed by your reviewer, I would request you to allow me a little space to say a few words regarding them.

In dealing with the topic of long wave propagation Prof. Mitra remarks that when certain conditions regarding the transmitting aerial such as the power available, etc., are combined with the Austin-Cohen formula, it is found that the best working wavelength is about 1/500th part of the distance separating the transmitting and the receiving stations. Your reviewer takes exception to this statement and doubts if it has any substantial basis. As far as I am aware, this simple and approximate rule is well known to practical radio-telegraphists, and, for a statement of it I would refer your reviewer to *Taschenbuch der drahtlosen Telegraphie und Telephonie*, edited by F. Banneltz, (published by Julius Springer, Berlin, 1927), page 387, and also to a paper by H. Rukop read at a meeting of the Deutsche Gesellschaft für Technische Physik, Danzig, in September, 1925 and published in the *Telefunken Zeitung*, January, 1926.

Your reviewer's remark that no conclusive evidence exists to definitely support the assumption of transmission of long waves by multiple reflection and of short waves by long-step process is indeed surprising. The fundamental difference between the modes of propagation of long and of short

waves as pictured in Figs. 5 and 6 of the address, and as is envisaged by the Eccles-Larmor Theory is now so well recognised that it has found place in such modern text-books as *Wireless* by Turner (pages 51, 53) and *Radio Engineering* by Terman (pages 561, 568, 571). An elaborate treatment of the whole subject is to be found in *Propagation of Radio Waves* by Pedersen, pages 194-200. An evidence, as conclusive as is possible under the circumstances, is to be found in a recent paper by Holingworth referred to by Prof. Mitra in his address (Ref. No. 25).

Regarding Fig. 11, I think it is sufficiently explained in page 21. As mentioned there it is a rough picture of the variation of the equivalent electron content with height. The heights of the region of low density between 80 and 250 km. are obviously related to those of high density and should naturally change with the changes of height of the latter with the hour of the day and season of the year. The broken-line portions of the curve are evidently for regions inaccessible to experimental investigation and the full-line portions—since the figure is only a rough picture—obviously depict the observed values and also the probable values as may be deduced from other observations.

Your reviewer is surprised at the low value of electron density immediately under the maximum of the E region (at 80 km.) and also in the region between the intermediate maxima. There is nothing surprising in this for the following reasons. Firstly, the density gradient near the lower boundary of these regions (E, E' and F') is extremely high. (See page 20 and Fig. 10 in the address; Ref. No. 48, paper by Appleton and Naismith

and also *J. I. E. E.*, 73, Oct. 1933, paper by G. Builder. The gradient is so steep that a variation of equivalent electron density from  $1.7 \times 10^5$  to  $4.1 \times 10^4$  takes place within a distance that cannot be sensibly measured.) If this gradient is maintained then evidently the density will fall to a very low value within a distance of a few kilometres. Secondly, so far as radio wave propagation is concerned, a density of 10 or 100 per c.c. is by no means low. A uniform rise of electron density from 0.0 to 0.3 at such heights is sufficient to produce enough curvature in the ray path of 1 km. wave to make it girdle the earth (see Ref. No. 24, Larmor's paper); and an electron density of only 1 per c.c. at a height of 80 km. is capable of bending back to earth 5000 m. waves leaving a transmitting aerial horizontally! Thirdly, an equivalent electron density of say 100 does not mean that the region is devoid of heavier ions. This density for the purpose of radio wave propagation is equivalent to a density of  $2.4 \times 10^6$  per c.c. of atomic nitrogen (see page 19 of the address); for all we know the regions of "low" electronic density might be filled with nitrogen ions having density of the above-mentioned order.

Regarding broadcasting on 10 metres, your reviewer finds it difficult to understand why the question of upwardly directed rays has been brought in because, surely, he argues, the aerial system would not be deliberately designed to radiate upwards! His difficulty would disappear if he recalls that an ordinary broadcasting aerial not only radiates horizontally but also at all angles inclined to the vertical.

In discussing absence of fading on such short waves Prof. Mitra rightly remarks that the radiated waves pierce the ionosphere at all angles of incidence and there being no reflected wave the chief source of fading is eliminated. Your reviewer, however, takes exception to this statement and says that even at such low wavelengths penetration of the ionosphere by the radiated waves does not take place at all angles of incidence. I wonder on what grounds this statement is made. If your reviewer is referring to the case of waves radiated from an aerial planted on the surface of the earth then certainly his statement is incorrect and is against known facts (see *Wireless* by Turner, page 51). If, however, your reviewer is referring to the case of an aerial taken hundreds of kilometres above the surface of the earth and placed in the ionosphere itself then the statement is probably true. But it is doubtful if in discussing broadcasting on 10 m. Prof. Mitra intended that the aerial system should be situated in the ionosphere!

For those not in possession of copies of the address it would be difficult to follow either the comments made by your reviewer or the reply thereto in this letter. But I am sure those interested in the subject will find no difficulty in procuring copies of the same, which, as mentioned

by your reviewer, presents a survey of the present day knowledge on the transmission of radio waves round the earth.

Thanks are due to Mr. Sil for his references to the hand-book edited by Banneitz and to Rukop's address of 1926 on the question of the optimum wavelength of a transmitter for a given distance.

1. In a matter involving a wide variety of physical conditions, any worthwhile relation between wavelength and distance should be based on the results of measurements on the transmissions from a number of stations located in different parts of the world. For instance, does the 1/500 rule find support in the data collected by Austin and his successors at the Bureau of Standards during the past dozen years? What, again, is the experience of the radio authorities of France, Great Britain and the United States?

2. In regard to long distance propagation, it is not clear as to what is "the fundamental difference between the modes of propagation of long and short waves... as is envisaged by the Eccles-Larmor theory." The brief reference in Turner's book and the discussion by Pederson of the possible methods of propagation cannot form adequate basis for the assumption of transmission of long waves by multiple reflections and of short waves by the long hop process. Prof. Hollingworth's paper is a preliminary statement of his observations with, as he himself says, some tentative conclusions. There is as yet no body of accepted facts which can be taken as conclusive evidence one way or other.

3. The electron density at different levels of the earth's higher atmosphere is still a subject of discussion and investigation. Information was sought in respect of any theoretical considerations or experimental data helping to account for the low densities at certain levels of the ionosphere.

4. It is not easy to understand Mr. Sil's remarks on the location of the antenna. There is nothing in the review to indicate that any locality beyond the immediate neighbourhood of the ground was under consideration.

5. The conditions necessary for bending back very low wavelengths such as 10 metres are obtained by the same equation that Mr. Sil uses to show that an electron density of 1 per c.c. is enough to reflect a 5,000 metre wave if it leaves the transmitting antenna tangential to the earth's surface.

The reviewer may be pardoned for pointing out that far from taking exception to any statement or entertaining a feeling of surprise at anything in Prof. Mitra's address, the review merely expressed genuine doubts and sought information on aspects of radio wave propagation which are still under investigation. Further no views of any kind were expressed except in the last para on the question of broadcasting.

9th April, 1934.

REVIEWER.

## Recent Advances in Anthropology, Ethnology and Ethnography in India.

By Dr. B. S. Guha,

Anthropologist, Indian Museum, Calcutta.

IN his otherwise well-informed account of the "Recent Advances in Anthropology, Ethnology and Ethnography in India" published in the January issue of the *Current Science*, it is regretted that Rao Bahadur L. K. Ananthakrishna Iyer should have made no reference to the works of several important investigators. I have no doubt that this omission was unintentional but if such accounts are to be considered as authoritative it is essential that due mention be made of all important contributions. I give below a summary of some of the anthropological works that have not been included in the above account.

Lt.-Col. Alberto C. Germano da Silva Correia has been carrying on investigations in the *École de Médecine de Nova Goa*, on the somatic characters of the inhabitants of Portuguese India and has published several memoirs, such as (1) *Les Ranes de Satary* (1928), (2) *Les Lusos-Descendants de l'Inde Portugaise* (1928), and (3) *Les enfants et des adolescents luso-descendants de l'Inde Portugaise* (1931). Dr. da Silva Correia's work has been regarded by European anthropologists as of very great importance and he has been the recipient of many honours in recognition of the valuable researches carried on by him in this country. He has further been instrumental in training several students, one of whom Dr. Voicunte Camotin has published an important anthropometric study of the Saraswat Brahmins, viz., *Os Bramanes Sarasvatas de Goa*, 1929.

Mr. K. P. Chattopadhyaya, Education Officer of the Calcutta Corporation, has published two papers of great merit on Social Anthropology, namely, "The Social Organisation of the Satakarris and Sungas" (1929) and "Contact of Peoples as Affecting Marriage Rules" (1931). In the latter paper Mr. Chattopadhyaya has been able to offer a more comprehensive theory of Social Organization than was advocated by Rivers in the light of the

recent discoveries of the Pentecost and Ambrym marriage rules.

Dr. Provash Ch. Bose, of the Department of Racial Biology recently opened in the Bose Institute of Calcutta, has within the last few years published a number of papers on physical anthropology and has received commendation from European scientists. At present he is engaged in carrying on an anthropometric survey of the aboriginal tribes of Chotanagpur and a preliminary account of it was recently published in the *Transactions of the Bose Institute*.

Mr. B. K. Chatterjee of the Anthropological Laboratory of the Zoological Survey of India has carried out an elaborate study of the somatic affinities of the Behari Brahmins; this is soon appearing as No. 2 *Anthropological Bulletin* of the Zoological Survey of India.

Dr. Irawati Karve, a pupil of Dr. Ghuriye, has recently returned after taking the Doctorate degree in Anthropology from the Berlin University where she worked under Prof. Eugen Fischer. The results of her investigations on the eye colour of the Chitpavan Brahmins published in the *Zeitschrift für Morphologie und Anthropologie* (Band XXIX, 1931) has greatly added to our knowledge of the significant distribution of this trait among the Konkanasth Brahmins of Western India.

Lastly, Mr. P. O. Boddington's work on the Santali language and folklore and Prof. P. C. Mahalanobis' statistical study of Indian anthropometric data require mention. The former has devoted his entire life to this work and the Norwegian Institute of Human Culture has recently published a sumptuous volume from his pen. A great portion of Prof. Mahalanobis' statistical analysis of the anthropometric data taken by the late Dr. N. Annandale has been published in the *Records of the Indian Museum* and the rest is expected to be completed soon.

## Research Notes.

## Phase Boundary Potentials.

It has frequently been suggested that surface reactions and surface equilibria are to a large extent controlled by the potential differences (P.D.) which exist at the phase boundaries. In Monograph No. 83 of *Actualités Scientifiques et Industrielles* (Hermann et cie Paris, 1934), E. K. Rideal has critically surveyed the present state of our knowledge on the subject of phase boundary potentials. The earliest type of phase boundary potential known is that recognised by Volta in 1808 at metal to metal interfaces. This Volta P. D. ( $\bar{V}$ ) is modified by the presence of a film on either metal such that if  $\Delta v$  be the potential across

the film, the new volta potential  $\bar{V}_1$  will be  $\bar{V}_1 = \bar{V} + \Delta v$ . E. K. Rideal and his colleagues have developed a technique to measure with precision the P. D. between two metals suspended in a gas after ionising the gap between the two surfaces by means of short range  $\alpha$ -particles from polonium. With this apparatus they have been able to study the effect of surface films on the volta potential and thereby obtain interesting data on the adsorption isotherm of a polarisable vapour such as ethyl alcohol on gold, and on the rates of evaporation of unimolecular films from metallic surfaces both pure and contaminated. The results indicate that the effect of poisons on the

volta potential of catalytic surfaces may alter considerably the critical energy increment for the surface reactions.

Similar measurements of the effect of film forming materials on the phase boundary potentials at air-liquid interfaces have yielded a number of important generalisations. The different phases in which films can exist show different characteristic molecular contributions to the phase boundary P.D. defined by  $\mu = \Delta \bar{V} / 4\pi n$  where  $\Delta \bar{V}$  is the change in the phase boundary P.D. caused by the presence of  $n$  molecules per sq. cm. The values of  $\mu$  which are determined mainly by the polar groups in the molecule, are further influenced by the presence and position of double and triple bonds in the hydrocarbon chain. The measurements also yield information regarding the molecular arrangement of high molecular weight complex bodies such as the long chain polypeptide units of gliadin, at an air liquid interface. Further the course of chemical reactions actually taking place in the phase boundary could be followed by observations of the rate of change in the phase boundary P.D. Such reactions at liquid interfaces are of special importance because of the many biological implications.

Not much is known about the phase boundary potential at liquid-liquid and liquid-solid interfaces. As is well known, the P.D. between a metal and a solution containing its ions involves the volta potential as well as the difference in free energies between an adsorbed ion and one in solution. If the electrolyte is insoluble in one phase but readily adsorbed at an interface a true phase boundary potential should result. This is probably the case for the glass electrode of Haber when placed in a solution containing metallic ions, e.g.,  $\text{Ag}^+$  which are strongly adsorbed although the electrode is reversible for  $\text{H}^+$  ions which are distributed in both aqueous and non-aqueous phases, the thermodynamic concentration remaining constant in the glass.

It is hoped that more investigators will be attracted to this interesting field.

M. A. G.

#### Heavy Water and Tumour Growth.

THE production of heavy water in quantities easily available for experimental purposes, has stimulated work on its biological properties. Taylor, Swingle,

Eyring and Frost reported that in concentrations ranging from 85-100 per cent., heavy water possessed marked toxic effects on fresh water organisms. Lewis found that 99 per cent. heavy water completely inhibited the germination of tobacco seeds. With the accumulation of larger supplies of water at Princeton, arrangements are now being made to ascertain its effect on the growth of cancer cells.

The work of Saguira and Chesley on the effect of heavy water on the viability of mouse sarcoma and melanoma is of great interest (*Proc. Soc. Exp. Biol. and Med.* **31**, 659-660). These authors have shown that at concentrations of 14.8 and 40 per cent. heavy water, the proliferating capacities of the tumours, mouse sarcoma 180, and the Passey mouse melanoma are unaffected. The tumour fragments which had been immersed in Locke-Ringer solution made up in ordinary and in 40 per cent. heavy water grow normally when transplanted into animals. Histological examination of a number of tumour tissues after immersion in heavy water and ordinary distilled water were essentially similar in swelling, jelly-like appearance, and the hydropic degeneration of the cytoplasm with nuclear degeneration.

#### Petalody in *Thespesia populnea* Cav.

WHILE giving specimens of *Thespesia populnea* for class work, a flower was observed in which two of the stamens were transformed into petaloid structures. The rest of the stamens of the staminal column were quite normal both in their number and their size. Nor were any transitional stages from normal stamens to petaloid structures to be found. A search was made of the rest of the flowers but no case of petalody could be seen. About a hundred and fifty flowers from the tree from which these were got, were also scrutinised, but with the same result.

Petalody which is the transformation of the primordia of the stamens into petals, is a terratological phenomenon brought about by pathological (De Bary) or physiological (Goebel) causes. The sporadic transformation of a few stamens into petaloid structures in this case would appear to be due to some pathological cause by which certain localised portions, i.e., a couple of stamens, assume a petaloid expansion—a form which first indicated the foliar nature of the stamen.



Recently a case of petalody of the entire androecium of the cotton was recorded by Sankaran (*Madras Agricultural Journal*, 19, No. 3), and I learn from the author that it has subsequently proved to be a case of floral mutation.

T. S. R.

#### Gametogenesis of *Senophylax stellatus*.

R. A. R. GRESSON (*Proc. Roy. Soc. Edin.*, LIII, Part IV, R.P. 322-346) describes the oogenesis in this Trichopterid insect, especially the behaviour of the cytoplasmic inclusions. He has determined that the nucleolar activity is very great and that fragments of the nucleolus which are found in the cytoplasm probably give rise to albuminous yolk. But the nucleoli do not contain chromatin as revealed by Feulgen's technique. The Golgi bodies which are in the form of rings or granules are, in the young oocytes, situated at one pole of the nucleus but increase in size and number as the oocyte grows and become distributed in the cytoplasm. They give rise to fatty yolk as in the majority of insects. It is suggested that the material derived from the ooplasm is added on to these globules of fatty yolk formed by Golgi. The rôle of mitochondria is not clear. In fact they are seen with great difficulty on account of their small size and the large number of yolk globules that fill the cytoplasm. Probably they add to the formation of protein yolk. The chromosome number is sixty and while in the younger stages of the oocytes, the chromosomes are clearly seen, later, they become obscure and are replaced by granules of chromatin.

#### On Bone Marrow in Hookworm Disease.

WALTER OSWALDO CRUZ (*Men. Inst. Oswaldo Cruz.*, Tome XXVII, Fasc. 4, 1933) has described the appearance of bone marrow in cases of infection by *Ancylostoma duodenale* and *Nicator americanus*. The macroscopical appearance of bone marrow from femur diaphysis presented a uniform red colouration as contrasted with the pale tone of other organs of the body due to anæmia and subsequent fatty degeneration. The microscopic structure presented an intense regeneration of parenchyma and a great decrease in fatty cells. The red colouration was due to the great number of erythroblasts laden with hæmoglobin. The author believes that the

etiological agent of the hookworm disease does not act directly upon blood causing a destruction through any process whatever, nor upon bone marrow producing an arrest of its regenerative capacity, nor to any paralysing toxic action.

He thinks that the parasite acts upon the iron metabolism causing a quantitative decrease of this element in the organism resulting in an abnormality in the evolution of the normoblast, which is clearly seen in the microscopic preparations of marrow.

#### Bionomics of Two Estuarine Crabs.

VERY little information is available about the habits and natural history of Indian crabs and Dr. Sunder Lal Hora's note on the Bionomics of two Estuarine Crabs (*Proc. Zool. Soc. London* for 1934, pp. 881-884, pls. i, ii) is, therefore, especially welcome. The note is based on observations of the author made in the field and on simple experiments carried out in the laboratory. The species dealt with, *Varuna litterata* (Fab.) and *Sesarma tetragonum* (Fab.), belong to the family Grapsidae, several members of which are known to live in estuaries—some have almost established themselves in fresh waters also—under conditions more or less similar to those described by Hora, and are, therefore, accustomed to live for considerable periods out of water. The area from which the author collected his material is also tidal and it would be interesting to know if the crabs are ever left under conditions of complete drought for long periods at any time.

As pointed out by the author, *Sesarma tetragonum* leads an active life, probably with somewhat restricted metabolism, during the "resting period," but it is difficult to say, without further evidence being adduced, if the habits of *Varuna* ever "closely resemble those of an aestivating animal". The crabs found "lying quietly" under dried slabs "with the legs folded beneath the body or spread out wide apart" may have been shamming death, as is commonly done by a large number of animals under similar circumstances; the behaviour of active crabs when placed on dry slabs seems to point to this view.

Dr. Hora's remarks on the burrowing habits of *Sesarma tetragonum* are of interest. Some other species of *Sesarma* and of a few other genera of the Grapsidae are also

known to burrow deep holes in the somewhat marshy ground on which they live. It is, however, interesting to note at Uttarbhag *Sesarma* burrows in dry ground.

Dr. Hora's observations as also his photographic reproductions are both interesting and instructive and it is to be hoped that he will be able to continue the work he has so well started.

B. N. C.

#### Studies on the Spermatocyte divisions in *Ascaris*.

H. P. STURDIVANT makes a significant contribution to the study of the Spermatogenesis of *Ascaris megalocephala* (*Journal of Morphology*, 55, No. 2, March 5, 1934) in his recent paper on the "Studies of the

Spermatogenesis of *A. megalocephala* with special reference to the central bodies, Golgi complex and mitochondria. He describes the centriole of the spermatocytes as a definite entity and its behaviour during the progress of the mitotic phase is observed. The disappearance of the centriole in the spermatid and its absence in the later stages are also noticed, and he draws the conclusion that the centrioles of the spermatocytes are not to be regarded as different from the centrioles in the other types of mitoses.

The behaviour of the Golgi complex from the early spermatocyte stage to that of sperm formation is inferred to represent the process similar to that of acrosome formation. Mitochondria which undergo very little change are interpreted as forming the prenebenkern.

#### Geological Aspects of the North Bihar Earthquake of the 15th January, 1934.†

**E**ARTHQUAKES are due to the fact that the earth is not a dead body, but is subject to continuous, though gradual, change in the shape of its surface due to the uplift and denudation of mountain ranges and the filling up of valleys by silt derived from the higher portions of the globe, and also because of periodic volcanic eruptions relieving the internal heat of the earth. The changes due to mountain building and to deposition are not uniformly distributed over the earth's surface, but tend to be restricted to definite belts known as geosynclinal belts, within which accumulated sediments suffer folding and uplift. One of the principal belts of such folding traverses the Indian Empire in three festoons—the first in the hills of Baluchistan and the North-West Frontier Province, the second along the arc of the Himalayas, and the third along the Assam-Burma are lying to the west of the Shan plateau. In the Indian Empire it is the tracts contained in, or adjoining these arcs that are particularly liable to earthquakes. The Peninsula towards which these mountain festoons appear to have been pressed by earth forces, is geologically much older and is relatively stable and but little subject to earthquakes.

A statistical study of earthquakes in India was made some years ago, and is contained

in a memoir on the "Seismic Phenomena in British India and their connection with its Geology" by Count F. de Montessus de Ballore, published in Vol. XXXV of the *Memoirs of the Geological Survey of India*. To this memoir is attached a map in which the author divides India into seismic regions according to their relationship to the geology of the country. Since this memoir was published, there have been the following important earthquakes in the Indian Empire:—

* Kangra	4th April, 1905.
* Baluchistan	21st October, 1909.
Maymyo	21st May, 1912.
* Srimangal & E. Bengal	8th July, 1918.
Rangoon	17th December, 1927.
Swa, Burma	8th August, 1929.
* Pegu, Burma	5th May, 1930.
Dhubri, Assam	3rd July, 1930.
Pyu, Burma	3rd-4th December, 1930.
Baluchistan	27th August, 1931.
* Upper Bihar	15th January, 1934.

All these, with the exception of the Maymyo earthquake, belong to the three festoons mentioned, or to adjoining tracts. From this list it will be seen that the Himalayan region had passed through quite a long period of seismic inactivity, the last earthquake associated with the Himalayas

† Sent by Dr. L. L. Fermor, Director, Geological Survey of India, for publication.—Ed.

(\* denotes very destructive earthquakes.)

being the disastrous earthquake of Kangra in 1905.

The earthquake of the 15th of January, 1934, appears to have been one of the greatest earthquakes on record. For, judging from reports received in the Geological Survey Office, the shock was felt by human beings upto a distance of about 1,000 miles from the probable position of the epicentre somewhere near the frontier between Bihar and Nepal, as records have been received from Peshawar, Multan, Jaisalmer, Deesa, Bombay, Dharwar and Madras. Practically all places from which reports have been received outside this circle have recorded that the earthquake was not felt. The sensitiveness of the observers obviously varies, because from a few places within this circle *nil* reports have been received. To the east and south-east of the epicentral tract the distance to which the shocks were felt by human beings was much less. The shock was felt at Katha in Upper Burma and Akyab, but all places to the east and south-east of an arc joining these two places have returned *nil* reports, so that the distance to which the shock was felt in this direction was about 650 miles only. Evidently the old resistant block of the Peninsula was able to transmit the shock to a greater distance than was possible through the young folded ranges of Assam and Arakan with their less consolidated rocks. We may, perhaps, predict also that to the north in Tibet the shock cannot have been felt to so great a distance as in the Peninsula.

Owing to the frequent inaccuracy of clocks at railway stations, telegraph offices and private houses, it is difficult to obtain an exact record of the time at which the shock originated, and at which it reached the various places where it was felt. Seismograph records have, however, been received from the Alipore, Agra, Kodaikanal, and Colaba Observatories. At the first three observatories, the shock was so intense that the instruments failed to give complete records, so that the only complete seismograph record so far available is for the east-west component as measured at the Colaba Observatory, Bombay. From this it has been calculated that the shock actually occurred at about 14 hrs. 13 min. 22 sec. Indian Standard Time, or 8 hrs. 43 min. 22 sec. Greenwich Mean Time, on the 15th of January, 1934. Assuming the time of origin of the earthquake as calculated from the Colaba records to be correct, one can

calculate from the records of the preliminary waves given by Agra, Colaba and Alipore, that the epicentre of the earthquake is situated within a small triangle to the east of Darbhanga, assuming that the speeds of the preliminary and secondary waves of this shock are comparable with the average speeds of most earthquake shocks. This gives an epicentral position some 75 miles to the E. S. E. of Sitamarhi, which suffered the most severe damage of all towns in Upper Bihar. The actual position of the epicentral tract can, however, only be decided from the results of the surveys of the Geological Survey officers at present in the field, and it is not yet possible to say whether the actual epicentre of the shock lies below the alluvium of North Bihar, or whether the shock is due to a movement along the Great Boundary Fault that separates the Himalayas from the Indo-Gangetic alluvium in southern Nepal.\* The intensity of the shock at Khatmandu, though severe, was less than at Sitamarhi, but the condition of the less inhabited tracts of south-eastern Nepal has not yet been investigated. It is also impossible yet to say whether the phenomena accompanying this earthquake are to be attributed to one focus only, or whether there are subsidiary local foci.

As the earthquake was felt upto a distance of about 1,000 miles from the epicentral region in North Bihar, the "felt" area of the shock would have been approximately 3,150,000 sq. miles, had the distance of propagation been the same in all directions. Allowing, however, for a shorter distance of propagation to the south-east and probably also to the north in Tibet, it is evident that the recent earthquake is still one of the greatest ever known. For comparison one may mention that according to Davison, a well-known authority on earthquakes, the largest known earthquake is the Charleston earthquake of 1886, which covered about 2,800,000 sq. miles, whilst the "felt" areas for the Assam earthquake of 1897 and the

\* Since this was written, the Geological Survey officers working in Bihar and Nepal have returned from the field and have demarcated the epicentral tract as being 75-80 miles long with an east-south-east alignment through Sitamarhi and Madhubani. This means that the shock is not due to a movement along the Great Boundary Fault, but to some movement below the alluvium of North Bihar. A report by the officers concerned will appear in the *Records of the Geological Survey of India* later in the year.

Kangra earthquake of 1905 were 1½ million sq. miles and 2 million sq. miles respectively.

As to the intensity of the shock of the 15th of January, 1934, data received from officers in the field suggest that the acceleration must have been of the order of 10 to 11 feet per second per second in North Bihar and 8 feet per second per second in Khatmandu. In the great Assam earthquake of 1897 and the Kangra earthquake of 1905, values of 14 and 13 feet per second per second were obtained, whilst in the Pegu earthquake of 1931, values of 4 to 7 feet per second per second were obtained. These figures are of importance as a guide to the engineer and builder in calculating the stresses that buildings may have to stand.

The actual method of propagation of an earthquake shock to a distance is by waves through the surface of the earth's crust and along chords through the crust. Of great importance is the double amplitude of the long or surface wave, that is to say, the distance between crest and trough. This can be calculated from the acceleration just referred to, but as there is some doubt about suitable formulæ, figures for the Bihar earthquake cannot yet be given. It was estimated, however, that in the great Assam earthquake of 1897 the double amplitude of motion was as much as 10 to 12 inches in the most severely damaged tracts.

Whilst the compacted rocks of the Peninsula appear to have transmitted the shock to greater distances than the less compacted rocks of Assam and Burma, yet the earthquake was actually felt more severely on alluvium than on solid rocks. Places in the Brahmaputra valley, for example, further from the actual epicentre than the Shillong plateau, felt the shocks more severely. There appears also to have been reflection of the surface waves by the block of the Peninsula into the alluvial ground at its foot at Monghyr and Jamalpur, explaining the unusually severe damage done in these two towns compared with their distances from the probable epicentre of the earthquake. This is an example of the well-known principle that towns situated on soft alluvial soil suffer much more severely during an earthquake than those built on solid rock, other things being equal. Thus at Tokyo in the 1923 earthquake, it was that part of the city situated on low marshy ground that suffered severely, whilst the higher parts of the city escaped the worst effects.

To the inhabitants of North Bihar, however, the local effects are of much more importance than a general description of the effects of the earthquake. North Bihar is occupied by the Gangetic alluvium, which is of unknown thickness and consists of alternating layers of sand and clay, the sandy layers being full of water. The effect of the earthquake waves passing through this unconsolidated ground was to cause the opening up of fissures and small crater-like vents, up which sand and water from the less consolidated layers were squeezed or squirted to the surface. Reports show that these fissures were upto 20 feet wide though usually much less, and that the thickness of the lenticular layer of sand deposited on the surface ranges down from 3 or more feet close to the fissure to nothing at some distance from the fissure. In some cases these happenings have given us information concerning strata below the surface, for specimens of peat and partly fossilised wood have reached the surface through sand vents and fissures in both Purnea and Champaran. As wells in the alluvium tap the sandy layers for their water content, it is not surprising that a large number of the wells in North Bihar became choked with sand.

As regards other phenomena of the earthquake, the reports received by the Geological Survey indicate that the total duration of the shock was from 3 to 5 minutes, as recorded by a large number of observers upto some hundreds of miles from the epicentre. Many observers recorded the shock as continuous, whilst others mentioned one or more periods of maximum intensity connected by periods of less intensity. Some observers record distinct shocks. Over a very large tract observers reported a rumbling noise sometimes preceding but often simultaneous with the earthquake shock, and this noise is variously compared to the sound of a train entering a tunnel, of motor lorries and of aeroplanes.

The question that has frequently been asked since the earthquake is whether North Bihar is likely in the future to suffer from greater seismic activity than before the shock of the 15th of January, and what is the importance of the aftershocks that are being felt at intervals. A big earthquake takes place because of the accumulation of strains within the earth's crust which are at least in part discharged by the earthquake. The aftershocks indicate that the whole of



the strain was not discharged by the main shock. The general history of earthquakes is that after a severe shock aftershocks occur for a period of months or even years, after which there may be a period of relative quiescence of years. This means that the major portion of the strain has been released, and it is only if the cause which produced the original strains continues to operate causing further strains to accumulate, that another severe shock may

be ultimately expected. Unfortunately, geology has no means of predicting whether the occurrence of a big earthquake confers immunity upon the region where it has occurred for a long period of time, though this is the usual position. This means that in rebuilding in areas damaged by earthquakes, engineers should take account of the maximum acceleration hitherto recorded from that earthquake region and arrange accordingly in their buildings.

### Micro-Climatology.\*

By L. A. Ramdas,

*Agricultural Meteorologist, Poona.*

#### INTRODUCTION.

IN meteorology we have been concerned in the past with the prediction of weather over comparatively large tracts of country. The large-scale phenomena in the earth's atmosphere extend up to several kilometres above the ground and contribute to what may be called "macro-meteorology". It is usual to consider the surface of the ground and the adjacent air layers up to about 2 metres above ground as disturbing factors. When the meteorologist, however, turns his attention to problems relating to agriculture he finds that it is just this disturbance zone which assumes great importance.

Three years ago, the speaker, in collaboration with a few other workers, undertook a detailed investigation of phenomena taking place in the air layers near the ground.<sup>1, 2, 3</sup> With the creation of the Agricultural Meteorology Branch towards the close of 1932, our studies received a new orientation and the programme of work has included, among other items, also a study of the variation of the micro-climate in different environments, e.g., inside and outside different crops.

In Europe Schmidt, Geiger and others have been studying the micro-climate in temperate latitudes during the past few years and have made numerous important contributions to this new subject.<sup>4</sup>

The International Commission on Agricultural Meteorology at its last meeting at Munich<sup>5</sup>

(September 1932) passed several important resolutions emphasising the importance of "micro-climatology" and its investigation in all countries. Similar resolutions were also passed at the Conference of Empire Meteorologists,<sup>6</sup> London, 1929.

The aims of "micro-climatology" are (1) to investigate the physical laws underlying the deviations of "micro-climate" from "macro-climate"; for, a knowledge of these laws is essential for getting a fresh insight into atmospheric phenomena, and (2) to apply the theoretical results to practical ends, e.g., a knowledge of the regular deviations would enable one to predict possible conditions in the hitherto unsurveyed regions with some confidence. In the tropics, owing to the intensive insolation, the "macro-climate" may be expected to be more profoundly modified by variations in the environment than in higher latitudes.

Some of the important aspects of this new subject may now be summarised very briefly. The influence of orography and crops, problems relating to experimental technique, "effective rainfall", etc., will be discussed on a future occasion.

#### ROLE OF SOLAR RADIATION.

Most variations of atmospheric conditions may be traced ultimately to (a) variations in the intensity of solar radiation received at the earth's surface, and (b) variations in the disposal of the thermal energy derived by the earth's surface from solar radiation. The first factor varies with season and latitude. The second factor depends on (i) the exchange of heat between the surface of the ground and the layers of the soil which are affected by the diurnal variation of temperature, i.e., the "conduction process", (ii) the exchange of heat between the surface of the ground and the air layers in contact with it or, in other words, the "convective process", (iii) the

bibliography of micro-climatological papers upto 1930.

<sup>5</sup> Proceedings of the Commission on Agricultural Meteorology; Munich Meeting, publication No. 14, "Secretariat de L'organisation Meteorologique, International."

<sup>6</sup> Resolution No. XIII of the Conference of Empire Meteorologists 1929, Agricultural Section, Report (p. 11, paras 29, 30, 31 and 32).

\*Report of a lecture on "Micro-Climatology" at the Colloquium, Meteorological Office, Poona, on 10th April 1934.

<sup>1</sup> "Theory of extremely high lapse-rates of temperature very near the ground," by S. L. Malurkar and L. A. Ramdas, *Indian Journal of Physics*, VI, Part 6, p. 495.

<sup>2</sup> "Surface convection and variation of temperature near a hot surface," by L. A. Ramdas and S. L. Malurkar, *Indian Journal of Physics*, VII, Part 1, page 1.

<sup>3</sup> "The vertical distribution of air temperature near the ground during night," by L. A. Ramdas and S. Atmanathan, *Gerlands Beitrage Zur Geophysik*, 37, pages 116-17, 1932.

<sup>4</sup> *Handbuch der klimatologie*, Band I, Teil D, "Mikroklima und Pflanzenklima" Von Dr. Rudolph Geiger (1930). Contains an excellent

exchange of thermal energy between the ground surface and the atmosphere by radiation processes, which again are modified by the water vapour and carbon-dioxide content of the atmosphere, and (iv) the heat lost or gained by the earth's surface due to "evaporation" or "condensation" of water at the surface.

Detailed measurements of these complex factors which control what may be called the "thermal balance" at the earth's surface are necessary for a proper understanding of the phenomena taking place in the air layers near the ground and in the first few feet of the soil below. Investigations on these lines are in progress at Poona.

#### SURFACE CONDITIONS.

The colour of the soil determines the absorbing and the radiating power of the surface. A black surface absorbs most of the incident solar radiation whereas a white surface reflects a considerable fraction of it and is a poor absorber. Recent experiments at Poona show that a very thin coating of chalk over the black cotton soil depresses the maximum temperature by about 15°C. at the surface, 5°C. at a depth of 5 cms., and 3°C. at a depth of 10 cms. At depths of 5 and 10 cms. the minimum temperature also is lowered by about 2°C. These effects penetrate further downwards with rapidly decreasing intensity. The changes take a few days to be fully developed; on removing the chalk the normal conditions are restored gradually and the temperatures become similar to those under the untreated soil only after a few days.

Similarly, even a very thin coating of wet soil at the surface decreases the amount of heat conducted downwards because part of the solar energy received by day is utilized for evaporation. The effects of soil covers of different colours, of a crop cover, and of wetting the surface of the ground, on soil temperatures at various depths are being investigated at Poona.

#### SOIL CONDUCTIVITY.

The thermal conductivity of the soil is an important factor in controlling the distribution of temperature in the soil as well as in the air above. It varies with different soils and, in the same soil, with the water content. As more and more water replaces the soil air (air is a poor conductor of heat) the conductivity increases; but the specific heat as well as the apparent density also increase so that, beyond a critical stage, the effect of further increasing the moisture content is to depress the thermal diffusivity.

In general, during the day hours a well-conducting soil transmits more heat into the interior, the surface remaining comparatively cool; at night the heat so stored up is returned rapidly to the surface to compensate the radiation loss. In such soils, the diurnal variation of temperature has a small amplitude. In badly conducting soils the heat energy gained by day mostly remains at the surface which becomes very hot and, at night, owing to the radiation loss not being compensated for by heat conducted from below, the surface attains a low temperature. This results in a large diurnal range of temperature in a shallow layer at the surface. The importance of the heat conductivity of the soil in relation to conditions during winter may easily be anticipated. Experiments show that a compact undisturbed soil has a warmer surface at night than one in which the soil has been turned up and loosened at the surface.

Reports received from different places on damage to crops due to frost during the cold waves of January last show that crops irrigated prior to the onset of frost were less affected. A study of the thermal conductivity of different soils in varying degrees of packing and of moisture content is therefore of importance.

#### CONVECTION PROCESS AND RADIATION FROM THE EARTH'S SURFACE AND ADJACENT AIR LAYERS.

During a clear day, the ground surface becomes very warm owing to the absorption of solar radiation; the air in contact with it is warmed up in its turn and is in unstable equilibrium with the denser and cooler air higher up. Consequently, there is a considerable vertical exchange of air mass in the shape of warm ascending currents of air and cool descending currents. This gives rise to the well-known "shimmering". The thermal structure of the "shimmering" layer has been investigated by Geiger<sup>7</sup> and recently ourselves by taking temperature observations with a sensitive thermo-couple set at quick intervals. The vertical interchange of air masses or what may be called "Surface Turbulence" is confined to the first few feet above ground. Above it, is the horizontal flow with its associated turbulence on a larger scale. The effective upward transfer of heat due to both the surface and the free air turbulence is minimum near the ground and, therefore, the ground and the air layers immediately in contact with it attain higher temperatures during afternoons than the air layers higher up.\* Owing to the same reason the ground and the air layers near it cool more rapidly by night than the layers higher up. This results in a large diurnal range of temperature near the ground, the range rapidly decreasing with height. As may be expected in the higher latitudes, the frequency of frost is found to decrease with height. In tropical countries, however, owing to the fact that even during the night the ground is warmer than the cooling air above,<sup>8</sup> it may be expected that the height of maximum frost frequency will be a few inches above the ground. This is also supported by recent frost reports.

The conditions that prevail at night are equally interesting. Soon after sunset the ground and the air layers above it begin to cool rapidly by radiation. The air layers begin to stratify, e.g., at Poona it is observed that the cooling of the air by radiation in winter is of the order of 10°C. per hour during the first half hour after sunset, the fall of temperature being large near the ground and decreasing with altitude. Occasionally, winds of local origin set in for short periods during the night; then the stratification is disturbed temporarily, the air layers get mixed up and there is a rise of temperature as a result. Towards the end of winter, the sea breeze sets in in the evenings and continues for a few hours during the night.

<sup>7</sup> Page D. 26 of publication (4) above.

\*Temperature and humidity observations taken at several heights above ground, both above bare soil as well as inside a few representative crops at the epochs of maximum and minimum temperatures, are being discussed by the writer and others in a series of papers. Each crop is found to develop its own peculiar local climate, the deviations of which from the "open" depend upon the season and the growth of the crops.

<sup>8</sup> Ramdas and Atmanathan, *loc. cit.*

During such nights the convection and the radiation processes act simultaneously and bring about a more gradual and less accentuated fall of temperature than during calm winter nights.

#### WIND MOVEMENTS.

The complex thermal structure referred to in the above section has also its counterpart in the wind movements in the air layers near the ground. Simultaneous observations of wind velocity taken at various heights show considerable variations, the larger variations being associated with greater turbulence. It is found that there are three zones viz., (a) one near the ground in which the surface disturbances predominate, (b) an intermediate layer in which the air is relatively quiet, and (c) the regions above where air movement is more or less horizontal and where the large-scale turbulence investigated by G. I. Taylor and others prevail. Schmidt's<sup>9</sup> observations also show that the surface turbulence increases with the roughness of the surface, e.g., over a turnip field the variations in the wind movements are larger than over a bare plot.

#### LIMITS OF SURFACE CLIMATE.

The change from the surface to the climate of open space is not quite gradual. R. Geiger<sup>10</sup> quotes evidence to show that there is a level of transition at about 1½ to 2 metres above ground which would probably coincide with the quiet zone referred to in the previous section. In tropical regions it may be expected that, owing to the more intense insolation, the horizontal partition between the zone of vertical exchange and the zone of horizontal flow may be slightly higher up. Recent observations appear to show that this upper limit of the surface climate undergoes variation during the day, attaining a maximum height in the afternoon and coming down towards the ground in the evening and later during the night. Observations of the temperature distribution at short intervals of height and time after sunset indicate the rapid fall of this level which may be expected to coincide also with the level at which the nocturnal inversion of temperature begins. In short, the surface turbulence will not completely die away in the tropics even during winter nights owing to the greater warmth near the ground. In higher latitudes, owing to the weaker solar insolation, the surface turbulence will cease after sunset and the inversion of temperature may start at the ground surface itself.

#### THE WATER VAPOUR CONTENT IN THE ATMOSPHERE.

During all seasons of the year there is a considerable amount of evaporation of water from the soil surface. During the wet seasons it may

be expected that the specific humidity in the air would be more or less constant with height above ground, with a tendency to be a maximum near the ground during periods of sunshine. At Poona, the above state of affairs prevail during the monsoon season, i.e., June to September. During autumn, the upper layers of the soil rapidly desiccate and, by the time winter sets in, the loss by evaporation during day becomes smaller. It is still found that the usual decrease of vapour pressure with height persists even during this period. A surprising observation is that during night the above situation is reversed, i.e., water vapour is minimum near the ground and rapidly increases with height. It was somewhat difficult to explain this at first sight, but, measurements of the loss of water from samples of soil exposed under natural conditions at the surface of the ground during the day showed that the loss is actually compensated by the absorption of moisture from the air by the same samples during the night. In other words, the soil which is intensively desiccated during the day acts as an absorber during the night thereby producing a minimum of vapour pressure near the ground. These results will be discussed more fully elsewhere.

#### EVAPORATION.

The evaporating power of the atmosphere is measured by the loss of water in small reservoirs with suitable measuring devices. As a meteorological element evaporation expresses the combined influence of temperature, humidity, sunshine, etc., as a single factor. Recent observations at Poona with a series of Piche's evaporimeters at various heights show that upto 4 ft. the evaporation increases with height even during the afternoon when the ground surface has the highest temperature. The effect of wind is thus seen to be more pronounced than that of the high temperatures near the ground. The study of the variations of evaporation in different environments at the same place, as well as the standardization of different types of evaporimeters are in progress.

#### DEW FALL.

When objects thermally insulated from the ground lose more heat than they gain from the air in their neighbourhood, their surfaces attain a lower temperature than the air. This results in condensation of water vapour if the lowering of temperature is sufficiently large. In many parts of India dew deposition during the night is very pronounced during clear weather. Exact measurements of dew deposition are not available at present, but qualitative observations at Poona made with collectors with bright surfaces exposed at various heights during last winter show that dew deposition starts from a height of 6" to 1 ft. above bare ground and increases with height.

<sup>9</sup> Page D. 28 of (4).

<sup>10</sup> Page D. 31-34 of (4).

## Science News.

**Andhra University Employment Bureau:—**According to a notification of the Registrar of the Andhra University, an employment bureau whose object is to advise and guide the unemployed graduates and undergraduates of the University in the matter of securing employment, has been started. Graduates and undergraduates of the University desirous of availing themselves of the services of the bureau should correspond with the Registrar.

**Seventh International Congress on Industrial Accidents and Diseases, 1935:—**The Congress will be held in mid July 1935 at Brussels. The Congress will be divided into 2 sections representing the International Congress on Industrial Accidents and the similar Congress on Labour Medicine, both meeting together.

Rao Bahadur L. K. Ananthakrishna Iyer, one of the leading anthropologists of India, sailed for Europe on 23rd April on a few months' tour. Prof. Iyer, who is now 72 years' old, has been invited to deliver lectures on Indian Anthropology by various universities in Britain and on the Continent. He will represent India at the International Congress of Anthropological and Ethnological Sciences which will meet in London towards the end of July.

**The Government of India** have awarded the Central State Scholarship to Mr. Balwant Singh Anand, M.A., of Baluchistan to enable him to study for English Tripos at Oxford or Cambridge.

**Nanga Parbat Expedition:—**The second German attempt to climb some of the unconquered peaks of the Himalayas including the famous Nanga Parbat has arrived in India. It will be recalled that the first attempt to reach Kinchunga was made four years ago and proved unsuccessful. Herr. Willy Merke is the leader of the expedition consisting of thirteen other members. Their base camp would be at the foot of the Rakeit glacier which they hope to reach by the end of May. It is expected that the climbing of the Parbat would take them about two months.

**Vice-Chancellor of the Madras University:—**Mr. R. Littlehales has been appointed Vice-Chancellor of the Madras University.

**Imperial Council of Agriculture:—**The Council will start a marketing section for which the Government of India will give an annual subsidy of Rs. 1,00,000 for a period of three years. Mr. Livingstone of the British Marketing Board has been appointed Marketing Officer and he is expected to join duty early. In co-operation with the provincial marketing officers and in consultation with the trade, it is proposed to arrive at a national grade of standards for such commodities as wheat, rice and oil-seeds. It is also proposed to organise marketing surveys. The possibility of establishing 'exchanges' at the principal wholesale markets including arrangements for arbitration on quality based on accepted national standards will also be examined by the officer.

**Dry Farming Research:—**The Imperial Council of Agricultural Research has sanctioned a sum of Rs. 1,40,000 for subsidising research on Dry Farming at the Hagari Agricultural Station. A good portion of the aided districts constitutes a famine zone with a poor rainfall of capricious distribution. The scheme which is of a utilitarian character allows of the investigations in the laboratory and the field of the relation of soil moisture to crop growth, and methods of increasing the availability of moisture. It is also proposed to investigate the water requirements of the important crops of the tract, viz., sorghum, Italian millet and cotton.

**Jute Research in India:—**The Committee of the Indian Jute Mills Association have decided to invite Dr. S. G. Barker, Director of Research of the Wool Industry Research Association, Leeds, to visit India in the near future to study the position of the Jute Industry in India and formulate a research scheme to suit the industry's requirements.

**Institution of Engineers, Viceroy's Prize:—**The Council of the Institute of Engineers (India) has awarded the Viceroy's Prize of Rs. 500 for the year 1932-33 to Mr. S. Kamesam, B.E., M.E., A.M.I.E., Officer-in-Charge, Wood Preservation Section, Forest Research Institute, Dehra Dun, for the paper on "A New Principle in Wood Preservative Impregnation Technique and its application with special reference to chir, *Pinus longifolia*" for railway sleepers.

**Pasteur Institute of India, Kasauli:—**The thirty-second annual report of the Institute, recently issued, records several important advances achieved in the treatment of rabies. As a result of researches covering a long period, it has been shown that large doses of vaccine were superior to small doses in preventing rabies and that the Paris strain of rabies fixed virus was superior to the Indian strain in antigenic value. To give practical application to these results during 1932, the Paris virus alone was used in manufacturing vaccine, and a higher average dose was administered than had previously been in use. As a result of these measures the total number of deaths was 27 per cent. less than in any previous year. The percentage of death rate was as low as 0.57.

**Campaign against Locust Pest:—**Consequent to his discovery that adult locusts and particularly those on the wing fell speedily victims to a spray of finely ground sodium arsenite, Mr. H. H. King, formerly chief entomologist to the Sudan Government, will soon start a mass attack on locust swarms in northern Rhodesia. The experiment will be watched with great interest, particularly because the usual methods of combating locusts are mostly confined to their egg and hopper stages but so far no method of tackling the locusts in the winged stage is available. The problem is of interest to India and if Mr. King's experiment proves successful and safe a great advance would have been achieved in our methods



of combating this ancient enemy of the agriculturist. Mr. King's plan of campaign is to fly to and fro across the line of advance of the swarms of locusts and fill the air with fine poison dust discharged from special blowers mounted on the wings of the machines. In view of the fact that the natural dissipation of the cloud reduces in a short time the density of the poison dust to a point when its effects are no longer poisonous, it is unlikely that any danger will arise to human beings, crops and livestock.

*Archæological Commissioner for Ceylon*:—The *Ceylon Gazette* invites applications for the post of Archæological Commissioner in Ceylon on a five-year contract on Rs. 12,000 rising to Rs. 15,000 per annum.

Dr. S. L. Hora describes a few sedentary games of India in a recent number of the *Journal and Proceedings of the Asiatic Society of Bengal*, 29, No. 1, 1933. Indian traditional history has a large number of indigenous games, of which a few are described in the paper. Most of these have become extinct except in a few out-of-the-way places in the country, which have not come under the influence of Western culture and where the games of the West have not penetrated. While Carrom, Cards and a few other sedentary games are Western invasions, the Indian labourer had, for the delectation of the long rainy evenings, a number of very interesting games which demanded a fair amount of skill and thought. Of these *Bhagchal*, *Lam Pusri*, *Lam Turki* and *Gol-ekush* are described by the author. Chess is probably our only still popular survival of the olden days.

*Lemuria—the lost continent*:—Indian geologists have long been familiar with the evidences in favour of the existence of an extensive southern continent known as the Lemuria during the Mesozoic era. Chiefly on the basis of palæontological studies of the Mesozoic rocks in the now widely separated areas like India, Africa, Australia and South America, geologists have concluded that in those remote times, an unbroken and continuous land connection existed between these distant regions across what is now the Indian Ocean and the Arabian Sea. While this conclusion has been generally recognised, there has been a difference of opinion among geologists regarding the way in which this continent broke up and led to the modern conditions of distribution of land and water. The older idea has been that this land area broke up as a result of the submergence of large portions underneath the sea; in other words, that the breaking up was effected by the foundering or sinking of the intervening portions of the continent. More recently several geologists who have been impressed by Wegener's theory of Continental Drift seek to explain the breaking up of the Lemurian continent in accordance with this theory, and postulate that the existing continents were grouped together during the Carboniferous period as one continuous land mass in apposition to South Africa and that subsequently, this continuous land mass was fractured, with drifting apart of the fragments to form the present continents. There has been considerable discussion regarding the relative merits of these two hypotheses, and it has now been

recognised that the final solution of this problem must await further researches. Speaking on this subject in his presidential address to the Indian Science Congress at Patna in January 1933, Dr. Fermor referred to the forthcoming Murray Expedition led by Col. Seymour-Sewell and said that, if during this expedition rock specimens in any quantity can be secured from the bottom of the ocean, we would get some "evidence helpful to the determination of whether India has been separated from Africa by the foundering of the intervening land or by drifting apart."

In the light of this, it is very gratifying to read the announcement made in the press only a few days back that this expedition has been able to collect extensive samples of rock material from depths of 2-5 miles below the surface in both the Indian Ocean and the Arabian Sea. It is expected that an intensive study of this material, which will shortly be undertaken at Cambridge, will make it possible to draw the map of a large part of the world as it existed millions of years ago in the days of the Lemurian continent. One of the important achievements of the Expedition is the discovery of "a submarine mountain range rising 10,000 feet from the ocean floor, whose summit is yet 1,000 feet below the surface between Socotra and Seychelles." So far as the breaking up of the Lemurian continent is concerned, the observations recorded during this Expedition seem definitely to support the older idea of the foundering of the land masses as against the theory of continental drift. Geologists all over India, will be eagerly looking forward to a fuller and more comprehensive account of the results of the Expedition, which will no doubt be published in the near future.

*Ring-Dykes in India*:—Subsequent to the publication of the note in *Current Science* (2, No. 7, p. 246) on the occurrence of a ring-dyke near Huli-kere, Mandya Taluk, by Mr. M. R. Krishnamurthi Rao and others wherein the authors had claimed that this ring-dyke was the second example of its kind in India, Mr. A. L. Coulson of the Geological Survey of India has written to us drawing attention to the occurrence of another ring-dyke which he has described from Mundwara in Sirohi State, Rajaputana.

*New Drying Agent*:—The first technical paper concerning a new drying agent prepared in the form of anhydrous calcium sulphate appeared in the June and October issues of *Industrial and Engineering Chemistry*. The desiccant is efficient, versatile, inexpensive, regenerative, neutral, inert and insoluble in organic liquids and can be prepared in the form of powder or granules of any desired size. A number of laboratories, interested, have made trials with this new desiccant, and it will soon be produced on a commercial scale.

*Chemical Age Year Book, 1934*:—The latest publication of this highly useful book (published in January 1934) is bigger than usual and contains revised and extended tables of data and notes invaluable to the practising chemist. Some outstanding events of the year, names and formulae of common chemical compounds, physico-chemical tables, main provisions of the Pharmacy and Poisons Act, 1933, are only a few of the more important items besides the Diary chosen from the contents of this chemist's companion. We

heartily recommend this publication to every chemist.

*Fish slime and precipitation of suspended mud in water.*\* S. L. HORA.—The slipperiness of the body of a fish is due to the presence of a slimy mucus secreted by special skin glands. The function of the slime is supposed to be "to minimise friction with the surrounding water and to enable the fish to glide along easily". While investigating the biology of *Lepidosiren*, a lung-fish of South America, Prof. J. Graham Kerr found that the "mucous secretion of the skin of *Lepidosiren* appears to have a remarkable power of precipitating mud held in suspension in water". In connection with my work on the ecology of certain estuarine fishes Prof. Graham Kerr suggested to me to test whether the slime of these fishes reacts similarly to that of *Lepidosiren*. Water in which fishes had been kept for some time was used for testing this property, and it was found that this 'slime-solution' had remarkable power of precipitating mud held in suspension. A successful demonstration of the actual process was given in the meeting by using the slime of *Opichthys boro* (Ham. Buch.) which precipitated the mud within about a minute.

Investigations have been started for testing the slime in the case of several other clear-water and muddy-water fishes.

There appears to be a special biological significance of this phenomenon. "Water-breathing" fishes are usually suffocated in muddy water, and in several parts of India advantage is taken of this fact for fishing purposes. By the precipitation of the mud with the help of the mucus the water-breathing fishes are able to have clear water for respiration by means of their gills, which, it may be remarked, are very delicate structures, and likely to be choked with mud in dirty water.

*University of Madras.*—Applications are invited for the post of a Lecturer in Statistics, the salary of which is Rs. 210—15 (annual)—300 per mensem.

The appointment will be in the first instance for a period of three years and subject to confirmation thereafter.

The Lecturer will be required to deliver lectures, conduct classes (Diploma in Economics or any other special classes) and to engage in research and to assist in any other academical work relating to the departments of the University which may require his services.

The selected candidate will be required to enter into an agreement with the University according to the laws (*vide* Chapter VIII, Cal. Vol. I, Part I) and should join the appointment within a fortnight after the receipt of the order of appointment.

Applicants for the post are requested to forward their applications (9 copies) containing full particulars as to age, nationality, present position and salary, academic and other qualifications, teaching and research experience in general and in the subject, if any, research work or publications in the subject, together with copies of recent testimonials and names of two persons to whom a reference can be made. Applications should be addressed to the Registrar, University of Madras,

\* Abstract of a communication made at the March 1934 Meeting of the Asiatic Society of Bengal.

Triplicane P.O., Madras, and should be marked on the envelope, "Application for the post of Lecturer in Statistics" and should be sent so as to reach the Registrar on or before the 29th June 1934.

Canvassing by applicants will be viewed with disfavour.

Sir S. Radhakrishnan, Vice-Chancellor of the Andhra University, will be leaving India on 21st June 1934 to attend the meetings from the 16th July 1934 of the International Committee of Intellectual Co-operation of the League of Nations which will be held at Geneva. The Syndicate of the Andhra University at a meeting held on the 15th May 1934 appointed Rao Bahadur Dr. T. S. Tirumurti to act as Vice-Chancellor for nine weeks during the absence of Sir S. Radhakrishnan.

The Crop-Planning Conference called by the Government of India will assemble at Simla on June 8, 1934. It is understood that the object of the Conference is the adjustment of the production of agricultural produce to demand.

At the Ninth Congress of Pure and Applied Chemistry which opened in Madrid on April 5, Prof. H. E. Armstrong and Prof. R. Robinson, Waynflete Professor of Chemistry at Oxford University, received the degree of Doctor *Honoris Causa*.

*Applications invited* :—(1) Professor of Electrical Technology, salary Rs. 1,000-50-1,250 with an overseas allowance of Rs. 250 per month. Applications should reach the Director, Indian Institute of Science, Bangalore, India, not later than 1st August 1934. (2) Senior Botanical Assistant, salary Rs. 250-25-375 per mensem subject to an emergency cut of Rs. 5% p.m. Applications must reach the Director, Institute of Plant Industry, Indore, C.I., not later than 15th July 1934.

We acknowledge with thanks the receipt of the following :—

- "Nature," Vol. 133, Nos. 3359 to 3362.
- "The Chemical Age," Vol. 30, Nos. 768 to 771.
- "Canadian Journal of Research," Vol. 10, No. 2.
- "The Biochemical Journal," Vol. 28, No. 1.
- "Natural History," Vol. 34, No. 2.
- "Journal of Agricultural Research," Vol. 47, Nos. 11 and 12, and Vol. 48, Nos. 1 and 2.
- "Journal de Chemie Physique," Vol. 31, No. 3.
- "Science Progress," Vol. 28, No. 112.
- "The Review of Scientific Instruments," Vol. 5, No. 3.
- "Scientific Indian," Vol. 11, No. 64.
- "Medico-Surgical Suggestions," Vol. 4, No. 4.
- "Bulletin of the Patna Science College Philosophical Society," No. 4, January 1934.
- "Forschungen Und Fortschritte," Jahrgang 10, Nos. 9 and 10.
- "The Indian Journal of Agricultural Science," Vol. 4, No. 1.
- "The Indian Trade Journal," Vol. CXII, No. 1449 and Vol. CXIII, Nos. 1451 to 1453.
- "India Meteorological Department—Scientific Notes," Vol. 5, Nos. 56 and 57.
- "Actualites Scientifiques et Industrielles," Nos. 81 to 88.
- "The Journal of the Annamalai University," Vol. 3, No. 1.
- "The Journal of the Indian Mathematical Society," Vol. 1, No. 1.

## Reviews.

THE PLACE OF MINDS IN THE WORLD. Gifford Lectures. (Aberdeen, 1924-26.) By Sir William Mitchell, K.C.M.G. (Macmillan & Co., London. Pp. 374.) 12s. 6d.

When Bertrand Russell's little book entitled 'Problems of Philosophy' appeared two decades ago, F. H. Bradley remarked 'as if there are any problems in philosophy'. The suggestion is that in philosophy there is only one problem and that its solution cannot be advanced by the method of detached analysis of isolated themes. Anyway, after some thirty years of analysis, we seem to be in a more synthetic mood at the present time. The large speculative horizons of recent physics offer an invitation to philosophy to weave her web afresh in a larger and more inclusive pattern. Much of modern philosophy centres in the place of minds in the world, the theme of the Gifford Lectures of Sir William Mitchell. Indeed the status of mind in the universe may be said to be the water-shed of modern philosophy, ever since Descartes launched its career on the tough little boat of 'self-consciousness'. All current varieties of idealism and realism, vitalism and materialism spring from different attitudes to this problem. All forms of idealism assign a determining rôle to mind, individual or cosmic. If finite centres of mental life appear at a late stage of the universal drama, they contend that it is because the central core of reality itself consists of consciousness which sends forth its "flashes of uncreated light" when the theatre is ready. Pure idealism goes the length of resolving all things into mind. To it even matter is mind, it may be of a lowly order. Professor Eddington is the most eloquent contemporary exponent of this ancient panpsychism. Among historical types, Berkeleyanism is the most completely worked out form of this view. Platonism, represented in modern times by many varieties of Hegelianism, admits the reality of matter or something other than mind or spirit but assigns a subordinate place to it. According to this theory, matter by which the philosophers mean anything the results of science may reveal, is a condition that emerges in the activity of self-realisation into which ultimate reality is perpetually flowing. This school upholds therefore not the utter self-sufficiency but the supremacy of mind. And realism in all its forms challenges this

enthroning of mind. It makes determined attempts to show mind its place as a feeble and late arrival and a sort of Cinderella among the forces and entities that make up the world. Every attack and defence, sally and repulse in this complex and many-sided debate is represented in the history of Indian thought in the past. Advaita Vedanta may be said to correspond to pure idealism or spiritualistic monism reducing all things to one universal expanse of consciousness. Dvaita and Visishtadvaita align themselves with concrete or objective idealism recognising a dependent but distinct place for a reality other than mind or spirit. The Nyaya-Vaiseshika is Indian realism *par excellence*, with its realist epistemology and atomic cosmology. There is a renewed attempt at the present time 'to save the appearances' in Plato's phrase or in Alexander's words 'to order mind and objects to their proper places' in the scheme of things' and this series of Gifford Lectures is a notable contribution in this direction.

The book under review is the first of the series; the second seems to be reserved for the power of minds. One would have thought that the place of a thing cannot be truly determined apart from a consideration of its power of function in its milieu. Indeed this is the essential spirit and aim of the author's treatment. It is an elaborate attempt to show that mind is what it does and is not to be thought of as a self-subsistent entity 'in the skull' in accordance with the 'natural metaphysic of the human mind'. But one cannot say all things at once and perhaps we have here just enough of the function of mind in knowing as exemplified in the systematic activity of science and scientific world-building to indicate the locus and status of mind *vis-a-vis* the object of knowledge. The modern world is haunted by the fear of subjectivity. There has been a magnificent growth of knowledge in the past three centuries, but the interpretation of its final outcome is not clear and unequivocal. The inspiration that should have flowed from the realms of order that the various sciences have disentangled from the total matrix of experience and Nature has been stifled by certain clogging notions, the outcome of a naive common sense theory and a disabling philosophic tradition. Common sense may be sound in its instincts but common sense theory or *prima facie*

philosophy has been the source of much mischief in the history of thought. Common sense believes that it knows things as they are, but when it reflects that it requires eyes to see and light rays to convey the message from the object to the brain, it rushes to the conclusion that the object causes an impression in the mind and that all knowledge consists in a contemplation of these peripherally excited images or copies of external things. And when this common sense theory was enshrined in the philosophies of Descartes and Locke the ghost of subjectivity was born, which has not yet been laid, in spite of repeated attempts. It is a most disabling thing to realise that, do what we can, we can never get away from ourselves and penetrate into the objective universe as it really is. The world is sundered into phenomena and noumena, appearance and reality, secondary and primary qualities, perceptual objects and scientific objects and so on. Knowledge is stultified in its source and the creative faith that is the fountain-head of scientific inspiration, the austere endeavour to catch the object in its pristine purity untouched by the shadow of the self, are likely to be paralysed. It is not for nothing that Max Planck has been obliged to go out of his way to affirm his conviction of the objectivity and extra-mental character of the physical world. Whitehead protested against this bifurcation of nature in his earlier works but the fissure reappears in his later metaphysical works *Symbolism and Process and Reality*. And it is a question whether Mitchell also does not concede too much.

Mitchell's way out of the impasse is by distinguishing mental functioning into levels so that they may read naturally as an expanding causal system on the analogy of the physical structure,—fact, law and causal system. The 'royal road' from surface to depth is similar in both cases. The gulfs and doubling usually resorted to as regards the relation of mind and body and mind and object are the results of a wrong point of view and a wrong expectation. We stop at analogy with common sense explanation in the sense of familiarisation in terms of minuter but similar units and fail to follow the suggestion of fact to the natural conclusion. Instead of following the living line which opens out into a system of operations we think of mind as a self-enclosed entity and look for its essence inside the brain! This is in our author's terminology to

confound the living and the correlation lines. The brain is a condition of the mind's activity but a condition does not hold the secret of anything. What then is the locus of mind? Mitchell answers—wherever it functions. Well, the mind plays upon all things in heaven and earth. According to Mitchell, it is wherever it goes. In Indian terminology it appears whenever things are illuminated by it. This reminds us of the Advaitic theory of the self that it is infinite in its nature coincident with universal consciousness. Of course the modern term mind has to do duty both for the Atman or Sakshi and for Manas or Antahkarana. In his anxiety to free the notion of mind from materialistic implications, Mitchell pays no attention to the other equally important aspect of the idea, viz., the individual uniqueness or centrality of minds. Minds may go everywhere but they move from somewhere. They have a unique association with certain localised bits of space-time-material called bodies. Both reference to object and unique loci are essential constituents of minds. The very notion of *minds* in the plural would otherwise be inexplicable. Some forms of Idealism hold that the body is enough to be the centre of consciousness so that all differences between experiencers are only incident to their embodiment. Bosanquet is the most prominent exponent of this view in current literature. Advaita Vedanta holds a similar view. The one universal consciousness according to Advaita refracts itself into myriad selves owing to upadhis or limiting adjuncts. Lotze Pringle-Pattison and others oppose this theory and insist that finite individuality requires a central essence, a focal point, other than the material embodiment. Location in space-time-material can only be a condition of manifestation for a reality already there but cannot bring into existence what never was there. The Dvaita and Visishtadvaita schools represent this type of thought. They urge that the soul is atomic as centre of action but *vyapta* or all-pervasive in range of function and influence. Both the centre and the horizon are therefore to be duly included in any adequate theory of mind. Though this aspect of the problem is not dealt with in this volume (it may be reserved for later treatment) the principle and method of Mitchell's exposition is sound and fruitful, as indicated by the fact that the view of mind as a system opens out into expanding horizons taking in all the results of analysis in a



natural way. But though the method is sound it cannot be said that the full possibility inherent in it is worked out or even suggested. One who sets out to show mind as a growing system may be expected to take into consideration the larger views dominating the current schools of psychology, Hormism, Gestalt, Psycho-analysis, and Behaviourism and exhibit the levels of mind in action as it were. One misses concrete detail in the development of the theme. But the point of view is clear and is in the direct line of Platonism and Hegelianism and recalls Bosanquet's fine fragment 'Three Chapters on the Nature of Mind'. The opposite way is exemplified in the work of Bertrand Russell—*The Analysis of Mind*, in which he tries to build up what may be called a 'chemical view' of mind with the self-subsistent bricks of sensation and image. Powder the mind and think of its constituents as motes in a sunbeam—this is the way of Russell. It is clear that much depends upon the orientation of the thinker in these matters. If one has in view the higher spiritual values as embodied in the concrete achievements of human nature, art, religion, society and so on, one is likely to stress what may be called Platonic approach. Similarly, logical atomism springs usually though not necessarily from a mathematical and physical background.

A special feature of the treatment of Mitchell consists in the elaborate analogy between the mental and the physical structures. Fully half the book is taken up with the history and evolution of the fundamental concepts formative of the scientific outlook from Newton to Einstein and Planck. Throughout he traces the changing notions of matter and space and time and points the moral for a true interpretation of mind. Every crisis has involved a mistaken metaphor and has opened out when its restrictions were removed by a larger idea. In effect this part of the book seems an effective commentary on the dictum of Whitehead (though perhaps it was written earlier) that "all constructive thought, on the various special topics of scientific interest, is dominated by some such scheme unacknowledged but no less influential in guiding the imagination" (*Process and Reality*, Preface). Further, Mitchell makes use of the course of scientific thought to show that theory is no copy of reality but is a system of symbols pointing at objects. As the surface need not

resemble the depth, the symbol need not imitate the symbolised. Though he sets himself strenuously against all theories of 'psychic additions' and bifurcation of nature, one is left with the uneasy suspicion that he has conceded too much for the phenomenalist. Adapting the phrase of Mach that nature is a system of phenomena he follows out the implication of the notion of system which heals up the gulf with which the idea begins. But he seems to hold that phenomena in the sense of sensory appearance is coeval with the rise of organisms with the requisite apparatus. Phenomena and human minds rise together. Prior to the appearance of man upon the familiar world, colour and sound, etc., did not exist. But this gives up the case for objectivity at a crucial point. Relativity to the human organism and powers need not mean subjectivity at all. As Alexander would put it, we and our apparatus are only instrumental in selecting and focussing, and not in creating any part of our environment. On any other view, the 'old man of idealism' (by which he means the self-stultifying type of subjective idealism) is inescapable. A selective theory is in current thought associated with realism, but a thorough-going ontological idealism of a concrete variety may be built on its basis. The Indian theories of mind as illuminators or mirrors will be very suggestive in that direction. Mind will be a diaphanous presence with a centre but a potentially universal range, a power inherent in things that does not add to or take away from the material system, but only reveals it in greater or less degrees. As Bosanquet put it, mind may be usefully thought of as a power which exhibits itself at different levels like the ebb and flow of the tide. Anyway, the combination of science and philosophy exemplified in this book is rare and reminds one of Emile Meyerson's *Identity and Reality* and of Whitehead's *Science and the Modern World*.

Any adequate consideration of this book must wait for the publication of the second series. But the attentive reader can guess that the rôle that Mitchell is finally going to assign minds is likely to be nearer that of Plato and Hegel than that of Alexander or Whitehead. If 'nature takes up space and time,' 'if units are unities,' 'if nature is what it grows into,' 'if wave and particle are inseparable,' and their disjunction a legacy of commonsense metaphysic, one may safely hazard the prophecy that the full system

that Sir William Mitchell has up his sleeve is an original variant of organic spiritual idealism.

M. A. VENKATA RAO.

ESSAYS IN PERSUASION. By John Maynard Keynes. (Macmillan & Co., St. Martin's Street, London. Pp. xiii+376. 1933.) Price 5s. net.

"The Essays in Persuasion" of J. M. Keynes, the world-famous British Economist, are a collection of essays "taken out of the author's printed writings, whether books, or pamphlets or newspaper or Magazine articles." The book is divided into five parts, the first three of which, the Treaty of Peace and the War Debts, the Policy of Deflation and the Return to the Gold Standard, are closely inter-connected and were written by the author in the course of the last decade and a half "to convince his audience in time". The essays might have been more appropriately called, as the author himself says, "Essays in Prophecy and Persuasion" "for the prophecy, unfortunately, has been more successful than the persuasion." They are brilliantly written, and when we realise how true the prophecy has turned out to be, our sorrow is all the greater that the warnings were not heeded to in time.

The first part is a brief résumé of the author's views on the Treaty of Versailles of 1919, contained in his two books: the *Economic Consequences of the Peace* (1919) and the *Revision of the Treaty* (1921). Here the author points out most beautifully how impossible it was for Germany to pay the huge war indemnity imposed on her by the Allies. If Germany was responsible for the huge losses inflicted in the world in the course of the war, the French and British spokesmen who inflicted on Germany an impossible peace, completed "The ruin which Germany began". The European statesmen, urged by their vindictive spirit, abused their momentary victory to destroy Germany and Austria-Hungary, forgetting that thereby they were inviting their own destruction also, as the economic bonds of Europe are deeply intertwined.

The author first estimates the capacity of Germany to pay. By examining her exports and imports for the five years preceding the war and her annual production of surplus wealth, the author comes to the conclusion, that the loss of her territory, her foreign investments, her ships and her foreign

banking, the burden of her debts, the reduced productivity of her soil from lack of manure and of labour, would leave Germany with a favourable annual trade balance of only £ 50 m. calculated in pre-war prices, or at £ 100 m. allowing for the rise in prices of the post-war period. This sum could be capitalised at the present value (1919) of £ 1,700 m. or roughly at £ 2,000 m. Germany surrendered property valued at £ 500 m. at the time of the armistice and the remaining £ 1,500 m. should be paid by Germany in 30 annual instalments without any interest. But the Allies imposed on her a burden of £ 10,000 m. "The policy of reducing Germany to servitude for a generation, of degrading the lives of millions of human beings and of depriving a whole nation of happiness, should be abhorrent and detestable, even if it were possible."

But Reparations were closely involved with inter-allied indebtedness. In the course of the war, England borrowed from the U.S.A. £ 850 m. and during the same time, lent the Allies £ 750 m. so that the loans were more for financing the Allies rather than for England herself. The British Government have been pressing from the very beginning that the inter-ally indebtedness was not in the nature of an investment and should be entirely cancelled. In 1922, in the Balfour note, the British Government expressed their willingness to cancel the whole of what the Allies owed them and also to surrender their whole claims on Germany, if the U.S.A. would relieve them of their debt. This policy was not accepted by the U.S.A. but the Allies felt that the question of granting relief to Germany was intimately bound up with the question of their indebtedness to the U.S.A. though the U.S.A. refused to see any connection between the two. But if the Allies were to pay huge indemnities to the U.S.A. without full compensation from Germany "they may be expected to make constant attempts to evade or escape payment". The author therefore advised all the States to make a "general bonfire of all these paper shackles".

The second and the third books are the most instructive. The author quotes with approval a saying of Lenin that the best way to destroy the capitalist system was to debauch the currency. If Governments followed the policy of Inflation for a long time, they can confiscate, secretly and unobserved, a very great part of the wealth of their citizens. During the course of the war from 1914 to 1920, many countries

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adopted the policy of Inflation and since 1920, the same countries went through a period of Deflation and contracted their currency. The policy of Inflation which accompanied and followed the war, reduced the real value of the savings of the people to one-half in England, to  $\frac{1}{3}$  in France, to  $\frac{1}{12}$  in Italy and to nothing in Germany, Austria, Hungary and Russia. But the period of rising prices stimulated production and benefited the businessmen and the working classes.

But when Deflation began, prices began to fall and unemployment succeeded prosperity. In April 1929 there were 1,140,000 unemployed in England; in 1930, 10 millions were unemployed in the U.S.A., Great Britain and Germany and in 1932 the number increased to 12 millions. During all these years no important industry was making enough profit to expand. The primary products were, and are selling, at a price which do not cover their cost of production; and the consequent restriction in the production of the primary products had a further adverse reaction on manufactures, as the purchasing powers of the primary producers were still further reduced. Every fall of prices increases the burden of the national debt. The catastrophic fall in prices ruined millions of farmers. "When incomes are falling, there is no use of goods becoming cheap; cheapness due to increased efficiency and skill in the arts of production is a benefit; but cheapness which ruins the producer, is one of the greatest economic disasters which can possibly occur."

To remedy this state of affairs, people were asked to save more than usual and all expenditure on public works had to be stopped. The author criticised this view and said that if everyone were to save the whole lot of his income, everyone would be very soon out of work and very soon we should have no incomes to spend. On the other hand, activities of all kinds, local and national, were necessary to restore economic progress. Great enterprises must be set on foot. "To bring up the bogey of inflation as an objection to capital expenditure at the present time is like warning a patient who is wasting away from emaciation of the dangers of excessive corpulence."

In the third book the author discusses the merits of "Deflation" and "Devaluation" for stabilising currency. Deflation has two great drawbacks; it involves a transfer of wealth from all borrowers to

lenders; it brings about the ruin of businessmen by increasing their liability and it is not possible, even if desirable, for under it the burden of taxation would become intolerable. Devaluation or the stabilising of the value of a country's currency near its present value and which has been recommended by International Conferences, meets the ends of social justice. The author first arrives at the conclusion that stability of internal prices is more important than the stability of foreign exchange, though the latter was the primary object of financiers in the pre-war days and though it was easily achieved as all the countries of the world were on the gold standard and the fluctuations in the internal prices were very moderate. But when the stability of internal price level and the stability of the external exchanges are incompatible, the former is generally preferable; "Since the restoration of the gold standard will not give complete stability of internal prices and can give complete stability of external exchanges only if all the other countries restored the gold standard, I reject the policy of restoring the gold standard on the pre-war lines."

In spite of the author's warnings, the gold standard was restored by Mr. Churchill in 1925 "in order to improve the foreign exchange value of the sterling up its pre-war value in gold." This premature restoration of the gold standard by the policy of Deflation, increased the disparity between internal and external values, postponed all measures of capital expansion, put the export industries to trouble by reducing their sterling receipts by 10%, increased British wages by 15%, transferred wealth into the pockets of the rentiers, increased the burden of the national debt, unemployment and industrial disputes. To bring about a reduction of wages, the Bank of England restricted credit and this again increased unemployment.

Writing in 1931 soon after the beginning of the world's slump, the author advocated among other things the imposition of a substantial revenue tariff. A wide revenue tariff, which brought in an income of £50 m., the author pointed out, would relieve the pressing problem of the budget, restore business confidence, increase employment by the substitution of the home-produced goods for goods previously imported and by curtailing imports relieve the pressure on the balance of trade.

Writing in September 1931, after the

suspension of the gold standard, the author pointed out its great advantages to British trade and industry, the great stimulus to employment and the benefits of higher prices.

Writing about the future, the author is of opinion that there is no need for pessimism about our economic future and that "the standard of life in progressive countries one hundred years hence will be between four and eight times as high as it is to-day."

**BANKS AND THE MONEY MARKET.** By Dr. B. Ramachandra Rau, M.A., Ph.D., L.T., F.R.E.S. (Lalchand & Sons, Calcutta. Pp. xxi+257.) Price Rs. 2.

The author of this valuable monograph needs no introduction to our readers. No student of modern banking can afford to forget the association of his name with books like "Elementary Banking," "Present-Day Banking in India," etc. The present monograph which consists of the 4 lectures delivered by the author to the Institute of Bankers during the Winter Session of 1930-31 forms a companion volume to his previously published works on Banking.

The first lecture deals with the ideal Money Market and its organisation; the second with "Expansion and Contraction in the Present-day Currency System." The third lecture concerns itself with "The other Monetary Markets" and the fourth one with the "Ideal Monetary and Banking Standard". Lectures as these are, one would not be justified in expecting a very comprehensive treatment of that wide subject "Banking," for that would involve numerous references to the whole theory of banking and currency as also to the prevalent practices on the continent. Though some of the subject-matter dealt with may seem to be too simple to the trained practical banker, the major portion of the lectures is really helpful to the untrained minds. A number of constructive suggestions and new views are given in the final chapter and it is needless to say that the most experienced bankers, economists and businessmen would find this book a valuable addition to their library.

In conclusion, the author deserves to be congratulated in having placed this invaluable book in the hands of the students of modern banking. The get-up of the book is nice and the price is quite moderate. We have great pleasure in commending this book to all businessmen and students alike.

**A CLASS-BOOK OF BOTANY** (For Intermediate and Medical Students), by A. C. Datta, M.Sc., 2nd edition. (Oxford University Press, 1934.) Rs. 4.

Teachers in Indian Colleges have often been embarrassed to recommend to the students of Intermediate Science a text-book of Botany which completely covers their course of study, at the same time is well written, neatly illustrated and is of moderate price. Professor Datta has endeavoured to meet these needs and has successfully done so. We congratulate both the author and the publishers for the handsome volume they have brought within the reach of the Indian student.

The book follows the usual stereotyped method of dividing it into chapters on Morphology, Histology, Physiology, Ecology and Systematics. While the chapters on the first two and the last subjects receive full treatment, those on Physiology and Ecology are poorly dealt with. We wish that more care and attention had been bestowed upon these two chapters in view of the growing importance of these subjects in the teaching of Biology. We are afraid that the chapter on Ecology as given in the present book will give a wrong idea of the concept of Ecology to the beginner in the study of Botany. Ecology is a study of organisms in relation to their environment and as such, does not merely deal with the classification of vegetation into xerophytes, mesophytes, etc., and the study of the anatomical peculiarities of the various plants, as the reading of this chapter seems to suggest.

Much as we welcome this book we wish that an opportunity had been taken to change the method of treatment of the whole subject. Instead of beginning the book with a chapter on Morphology, Prof. Datta should have given a preliminary chapter on plant life in general and surveyed briefly the scope of Botany; then divided the book into sections on leaf, stem, root, etc., each section treating its subject-matter from all its aspects—morphology, physiology, etc. We feel that such a treatment would have made the book more interesting to the students and would not have given a detached view of the subject as it does at present.

In spite of the above criticisms we strongly recommend the book to students and teachers alike for its excellent get-up, its numerous neat diagrams and its surprisingly low price.

F. R. B.



